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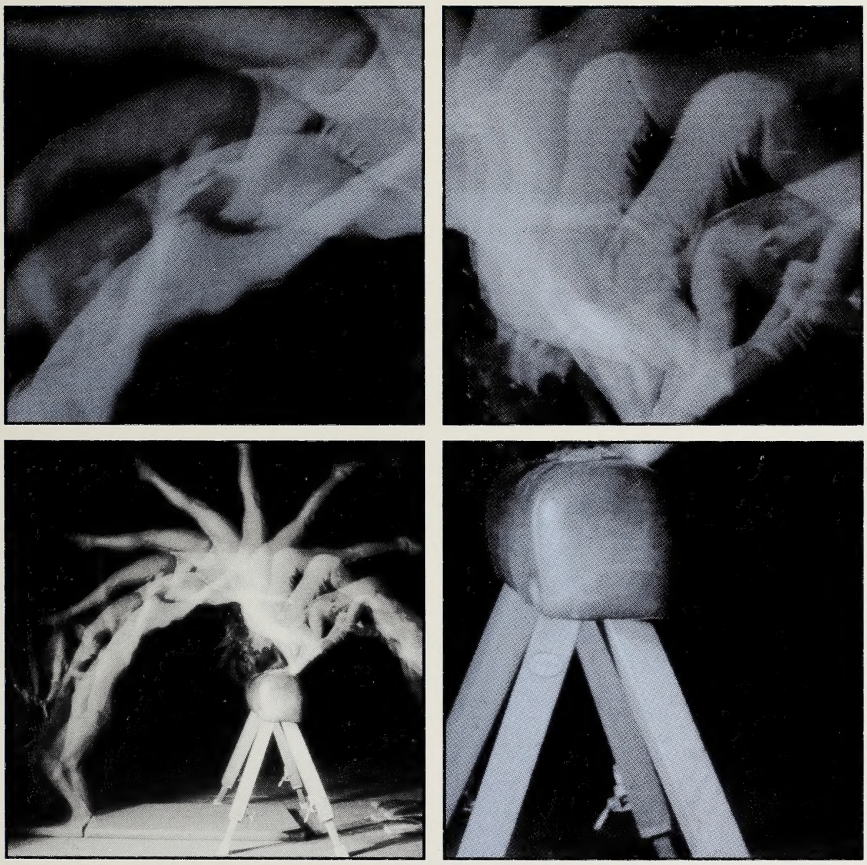
MODULE 3: THE BALANCE OF LIFE



MODULE 3: THE BALANCE OF LIFE
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Distance Learning

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Science 14

Module 3

THE BALANCE OF LIFE

Distance Learning

Alberta
EDUCATION

Science 14
Student Module
Module 3
The Balance of Life
Alberta Distance Learning Centre
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Welcome to Module 3!

We hope you'll enjoy your study of the Balance of Life.

To make your learning a bit easier, a teacher will help guide you through the material.

So whenever you see this icon,

turn on your audiocassette and listen.

Contents

OVERVIEW 1

Evaluation 2

SECTION 1:

THE BODY – BEAUTIFUL 3

Activity 1: A Worm, A Frog, and You 4

Activity 2: The Framework of the Body 10

Activity 3: What's That Muscle? 14

Activity 4: Are You Nervous? 21

Activity 5: Feeding the Systems 30

Activity 6: The Helper System 36

Follow-up Activities 40

Extra Help 40

Enrichment 42

Conclusion 42

Assignment 42

SECTION 2:

IT'S A SMALL WORLD 43

Activity 1: The Microscope 44

Activity 2: Life in a Small Package 58

Follow-up Activities 64

Extra Help 64

Enrichment 65

Conclusion 66

Assignment 66

MODULE SUMMARY 66

APPENDIX 67

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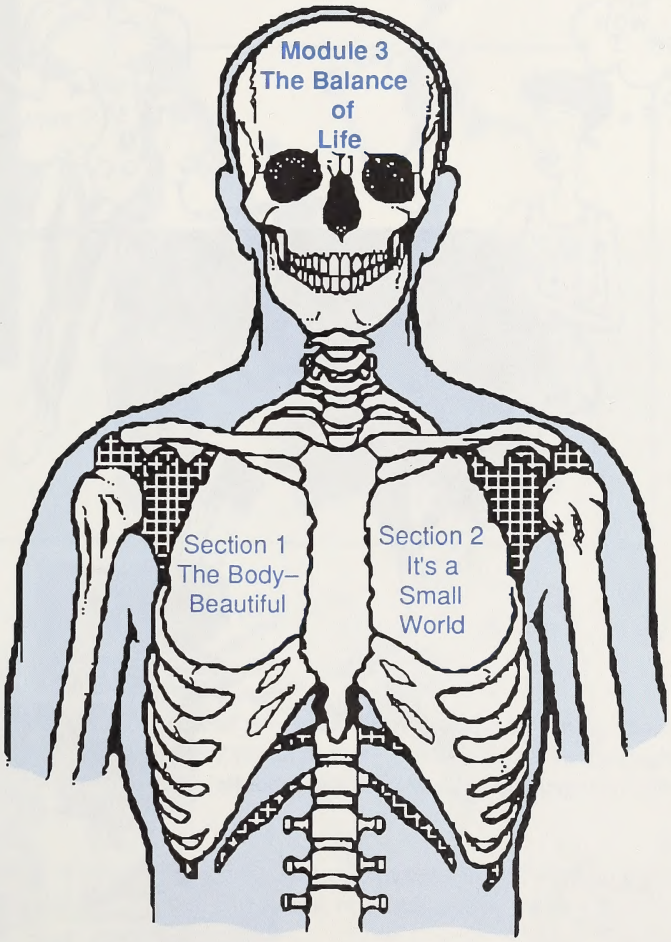
OVERVIEW

Your body is a marvellous collection of cells, membranes, tissues, and systems all working together to keep you healthy and alive. Do you realize what's going on in your body from day-to-day or even from minute-to-minute?

In this module you will explore your various body systems and study how they function together. You will look into a world too small to be seen with the naked eye and marvel at how similar living organisms really are.



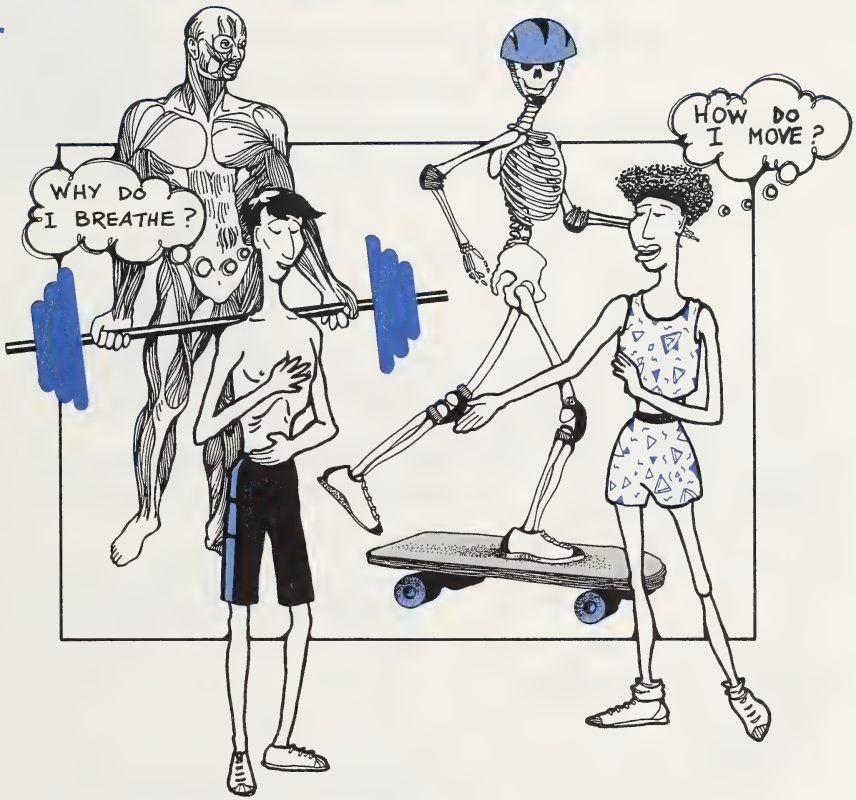
Evaluation

Your mark in this module will be determined by your work in the Assignment Booklet. You must complete all assignments. In this module you are expected to complete two section assignments. The assignment breakdown is as follows:

Section 1	=	60 marks
Section 2	=	40 marks
TOTAL	=	100 marks

WESTFILE INC.

1 The Body – Beautiful



Flex your arm, and then bend your knee. Do you know how many functions and systems are required for you to do this? How are you able to straighten your arm, lift a weight, or feel the texture of a piece of sandpaper? How and why do you breathe?

Your body is an amazing combination of separate systems working together to enable you to walk, run, play sports, or simply sit and watch TV.

To totally understand how your body functions, it is important for you to understand each of your body's individual systems and how they work together. This is what you will learn about in this section.

Activity 1: A Worm, A Frog, and You

What do a worm, a frog, and a person have in common? If you said, "They all have to eat," you would be correct. It is important for all living things to eat. Food is the fuel that makes the living machine of your body work.

digestive system - the system within the body which converts food to fuel and raw materials that can be used by the body

When you eat, swallow, and break down your food to provide energy for your daily activities, you use your digestive system.

hypothesis - an educated guess or a good estimate; what you think the correct answer is

1. Do you think the digestive system of a worm, a frog, and you would be exactly the same? Record your hypothesis along with the reason why you think your hypothesis is correct.

_____

_____

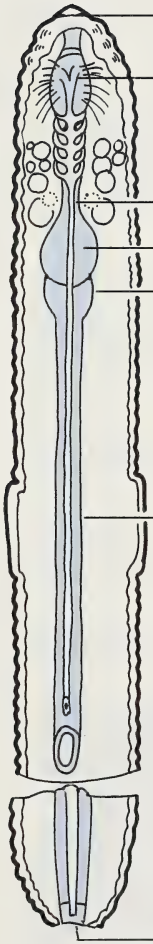
_____

_____

organ - a body part or group of tissues that performs a specific function for the body

Take a look at the inside of a worm to see exactly what is happening and what organs are used for digestion.

Digestive System of a Worm



mouth - the opening through which food is taken in or ingested

pharynx - a muscular tube that draws in food

esophagus - a muscular tube that moves food toward the stomach or crop

crop - a sack that stores food before digestion begins

gizzard - a muscular sack that starts digestion by breaking down the food into smaller particles by grinding it with sand

small intestine - a long tube where absorption of nutrients occurs Chemicals released by the small intestine break down food particles. The small intestine transfers these smaller food particles to the bloodstream for transport throughout the body.

anus - an opening, usually at the rear of an animal, through which indigestible material is excreted or gotten rid of

Use the diagram of the worm to help you fill in the blanks.

2. The digestive system of the earthworm is quite simple.

   Food goes in the _____, and waste is excreted through the _____. Most of the actual digestion and absorption occurs in the _____.

   Think back to your hypothesis and consider the worm diagram.

3. Do you think your digestive system is as simple as the worm's?

   Check the correct answer. ☐ yes ☐ no

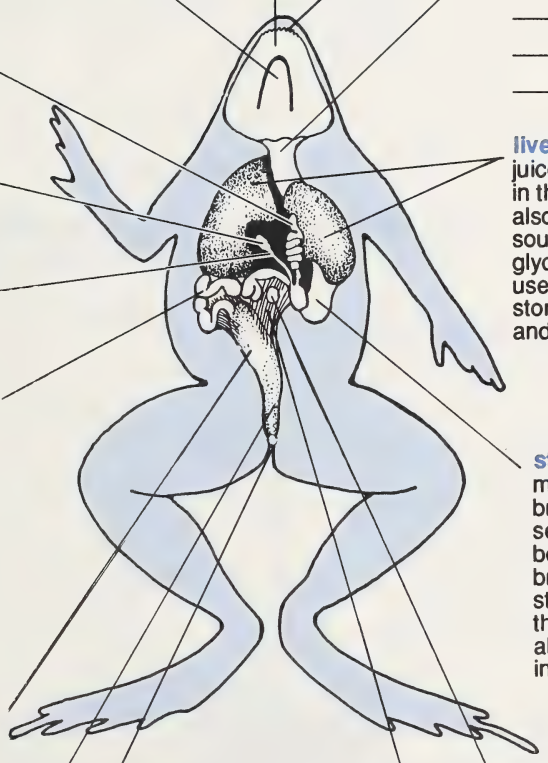
4. Do you think a frog's digestive system is the same as a worm's?

   Check the correct answer. ☐ yes ☐ no

Look at the digestive system of a frog and see if your answer is correct.

The Digestive System of a Frog

5. Fill in the function for the parts of the frog that you already know.



mouth – _____

tongue – pushes food back to the gullet

teeth – hold food and pull it into mouth

esophagus – _____

pancreas – secretes digestive juices

gallbladder – stores bile

liver – secretes a digestive juice called bile which aids in the breakdown of fats; also stores a quick energy source for the body called glycogen (a simple sugar used for emergency energy) stores vitamins A, D, E, and K

bile duct – moves bile from the gallbladder to the small intestine

small intestine – _____

stomach – uses thick muscles to physically break down food Acids secreted by the stomach begin the chemical breakdown of food. The stomach also regulates the amount of food allowed into the small intestine.

large intestine – absorbs water and does the final processing of wastes Vitamins are produced here by special bacteria which live in the intestine.

anus – _____

spleen – not actually part of the digestive system It produces and stores red blood cells for the circulatory system and provides iron, one of the building blocks of bile, to the liver.

cloaca – passes wastes to the anus

mesentery –holds organs in place; consists of thin bands or sheets of tissue

6. As you can see, the frog and the worm have several similar organs. List the organs found in both the frog and the worm.

_____

_____

_____

_____

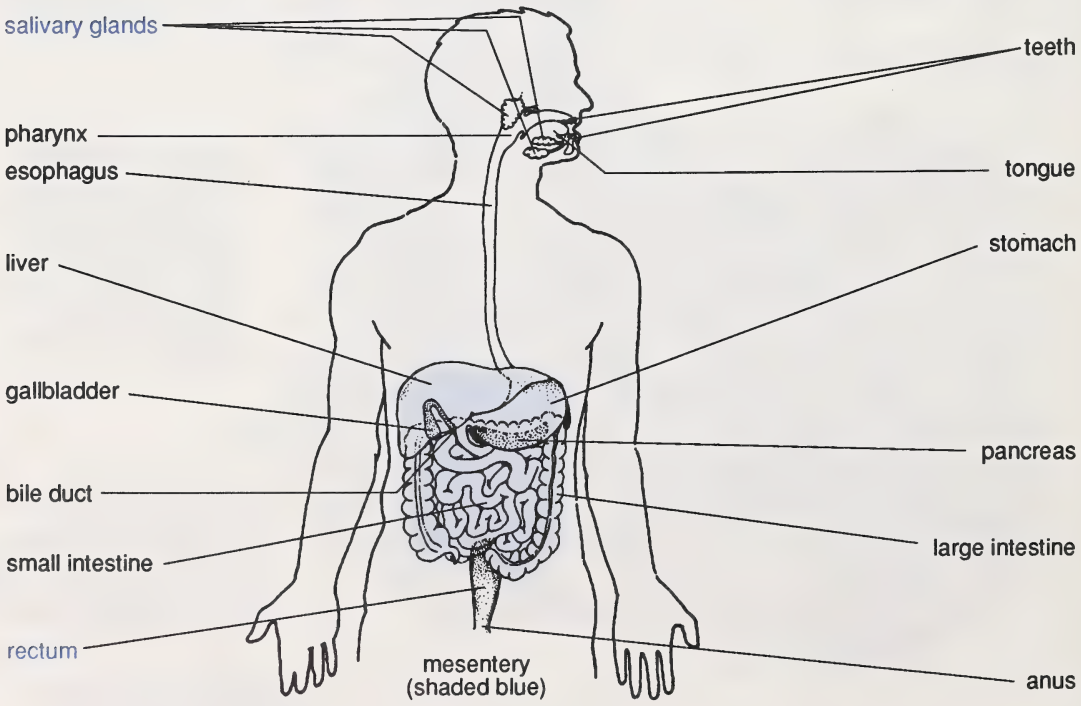
_____

7. Do you think your digestive system will be more or less complex than that of the frog? Remember what you have already learned about worms and frogs.

_____

The Human Digestive System

The following is a diagram of the human digestive system. It is inside you right now busily digesting your last meal.



8. Fill in the functions for the following parts of the digestive system.

teeth: _____

_____

tongue: _____

_____

salivary glands: produce saliva, a mild digestive juice that begins the digestive process

pharynx: _____

_____

esophagus: _____

_____

stomach: _____

_____

liver: _____

_____

gallbladder: _____

_____

bile duct: _____

_____

pancreas: _____

_____

small intestine: _____

_____

large intestine: _____

_____

rectum: temporarily stores wastes
Also aids in moving wastes out of the body.

mesentery: _____

_____

anus: _____

_____

Check your answers by turning to the Appendix, Section 1: Activity 1.

Activity 2: The Framework of the Body

Your digestive system is a very important part of your body, but how does it stay in place? Why do your arms bend only at the elbow and your legs only at the knee? This is because of a specialized framework within your body called the skeleton. Your skeleton is made up of bones. Bones are the support beams of the body. What do they look like? Why are they so strong and why do they bend at only one point?

Investigation: Chickens Have Bones, Too!

Materials You Need

- one cooked chicken bone (drumstick preferred)
- one cooked chicken wing
- one sharp knife

Steps to Follow

STEP A

Using your knife, remove the chicken wing and leg as shown in the following diagram. You will only need the shaded parts of the chicken for this investigation.

1. Take a look at the chicken wing. At how many points does the wing bend?

_____

2. Can you think of a good term for this bend?

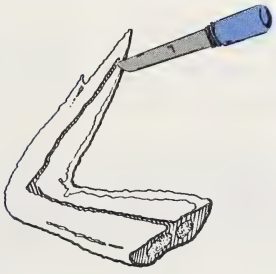
_____

_____

articulation - the point where two bones join Usually some sort of bending occurs at a joint or articulation.

STEP B

With your knife, carefully remove the skin and cut away the meat (or muscle). Be careful so as not to separate the joint.



OBSERVATION

3. Draw the bones and **articulations** that you find in the space provided.

ligament - a tough band of tissue that connects or holds your bones in place

STEP C

Look carefully at the joint of the chicken wing. It should be covered by a hard white material called the **ligament** This material is found at almost all of your joints and is used to hold your bones together.

OBSERVATION

4. Touch the ligament and describe how it feels.

_____

_____

cartilage - a smooth, rubbery substance that acts as a shock absorber for your joints

Ligaments not only hold your joints together. Along with another substance called **cartilage**, ligaments absorb shock and allow your joints to bend without friction.

STEP D

Take the chicken drumstick; brace it firmly and cut it in half with a heavy knife.

OBSERVATION

5. Was the bone easy to cut? Explain why or why not.

_____

_____

_____

_____

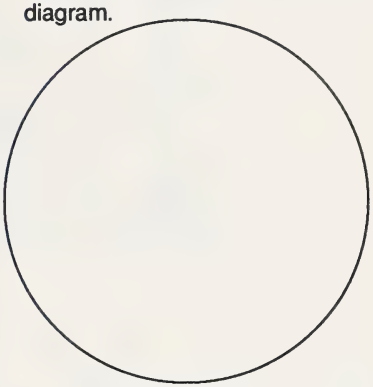
_____

STEP E

When you look at the inside of the chicken leg you will see it is brownish-red and spongy. Using the following chart, try to locate each type of bone in the leg.

OBSERVATION

6. Draw a cross section of the chicken bone in the circle provided. Label each of the three bone types in your diagram.



Compact Bone	Spongy Bone	Marrow
• is hard dense bone made of calcium and fibres • is white in colour • is the strongest part of the bone and is thickest at the ends	• has many narrow spaces giving it a spongy appearance • made of calcium and acts like a miniature shock absorber so your bones do not easily break	• found within the spaces and sometimes in the centre of a bone • produces red and white blood cells for your body

Your bones are strong because of a layered design. The hard outside compact bone backed by the shock-absorbing spongy bone makes for a very strong and durable structure.

Every part of your body that bends or has a bone in it (like your skull) is made up of this strong dense material. Bones allow you to keep your internal organs in place when you stand up, run, drive a car, or make any movement.

Check your answers by turning to the Appendix, Section 1: Activity 2.

Activity 3: What's That Muscle?

1. Your skeleton is a very important structure in your body, but what is the system that allows you to move that internal framework of bone?

_____

Have you ever wondered which muscles cause what movement?

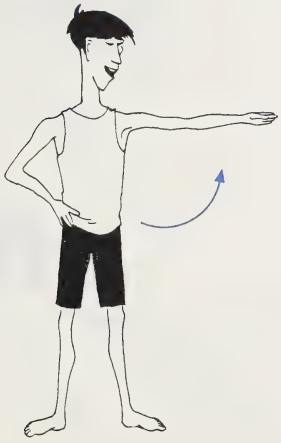
A list of muscles and their function is provided. Diagrams are also provided to show the specific movement of each muscle. Try doing each of these movements yourself. Follow what the diagram is showing you. Use a mirror or simply feel the muscle with your hand; you should be able to determine the location of the muscle on you.

tibialis anterior – lifts your foot upwards

gastrocnemius – pulls your foot downwards

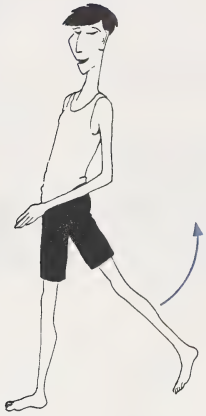
trapezius (traps) – pulls your shoulders upwards

latissimus dorsi (lats) – pulls your shoulders downwards

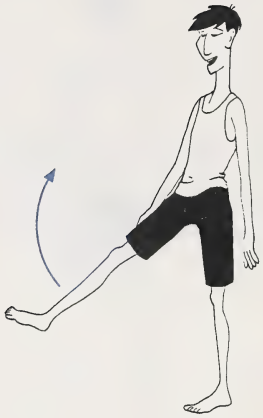


deltoid – lifts your arm from your side upwards

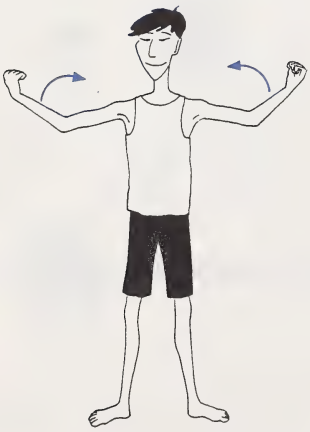
pectoralis major (pectorals or pecs) – pulls your raised arm in towards and in front of your body



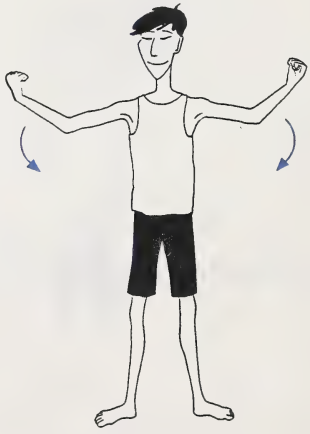
gluteus maximus – pulls your whole leg up behind you



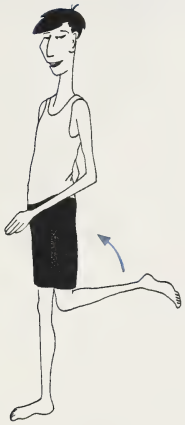
sartorius – a long muscle that helps pull your whole leg forward



biceps brachii (biceps) – bends your arm up in a curl motion at the elbow



triceps brachii (triceps) – straightens your arm at the elbow



hamstrings – bends your leg at the knee
The hamstrings are made up of a group of muscles.

quadraceps (quads) – straightens your leg at the knee
The quadraceps are made up of a group of muscles.

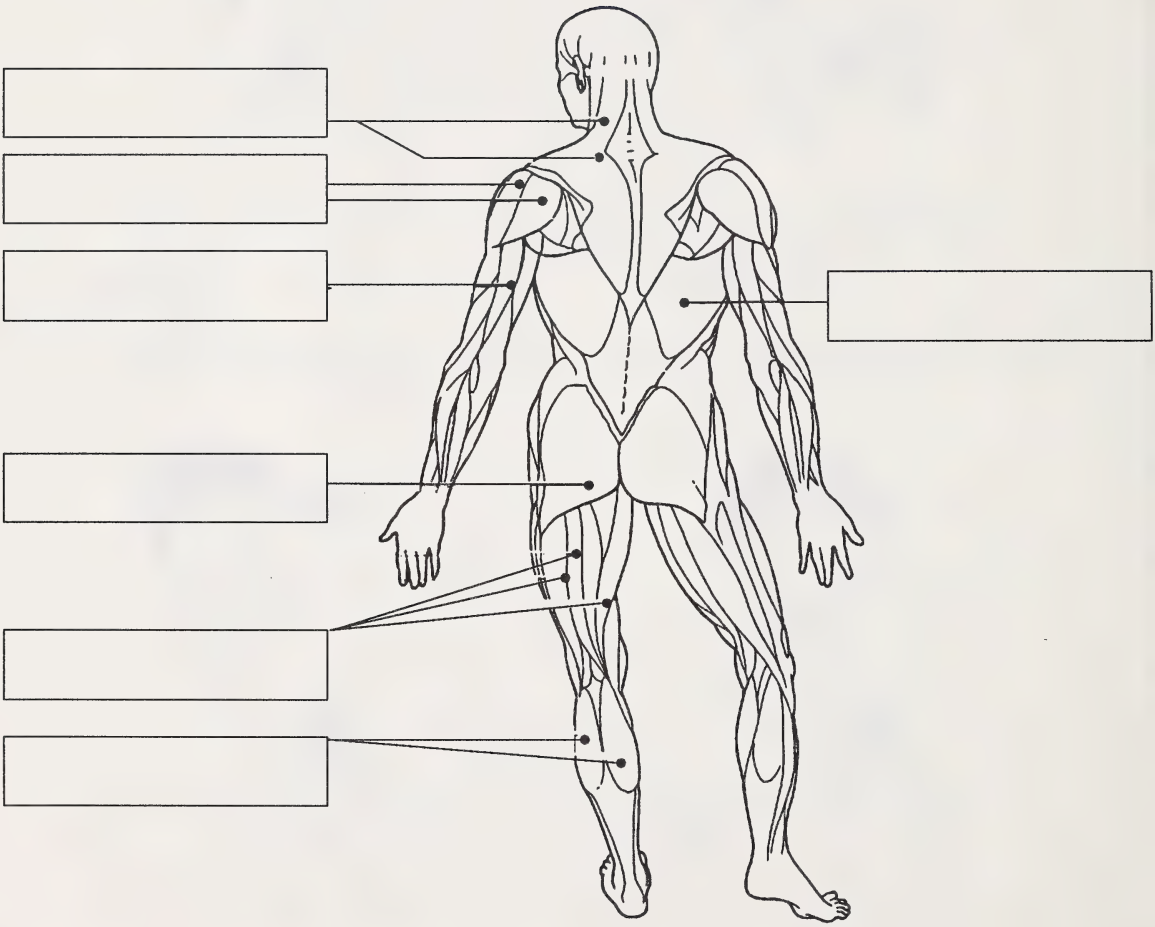
sternocleidomastoid – helps to open your mouth

masseter – a powerful muscle used to close your mouth

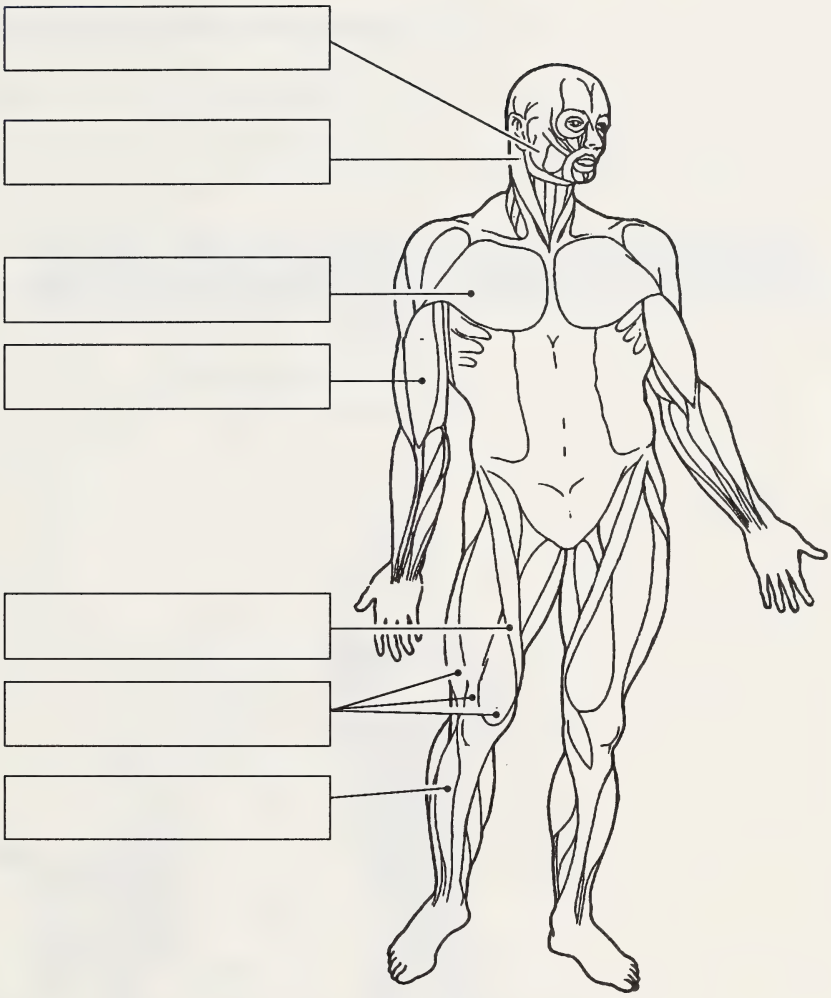
Did you locate all of these muscles? Now put your knowledge to a test.

2. Label the muscles in the diagrams which follow. You can use the list of muscles and the functions to help you.

a.



b.



Check your answers by turning to the Appendix, Section 1: Activity 3.

Did you notice how your muscles worked in pairs when you made the movements?

3. Explain how each pair of muscles move a joint.

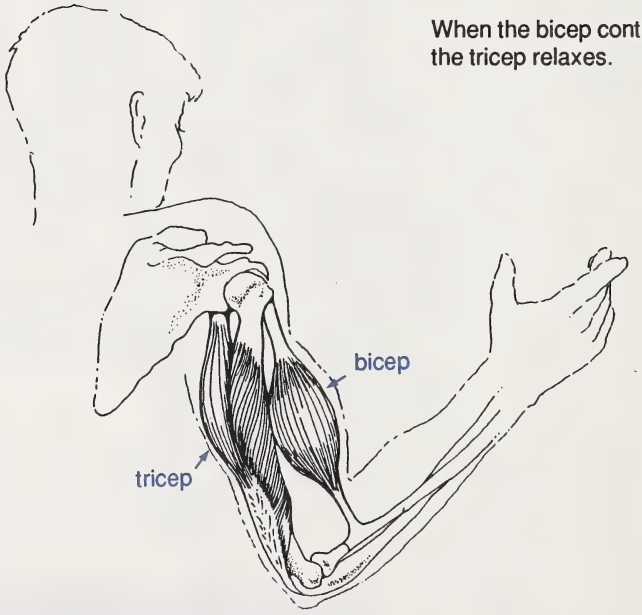
_____

_____

_____

_____

Muscles are limited in that they can only pull across your joints. There has to be cooperation between your muscles so that when you bend your arm in a curl fashion, your bicep contracts and pulls your arm upward while your tricep relaxes and gets longer.



When the bicep contracts, the tricep relaxes.

Now when you want to straighten your arm the reverse must happen. Your bicep must relax and lengthen while your tricep tightens and pulls your arm to its straight position.

4. Why is it important to your body to have two muscles crossing each articulation (joint)?

_____

_____

_____

_____

Check your answers by turning to the Appendix, Section 1: Activity 3.

Activity 4: Are You Nervous?

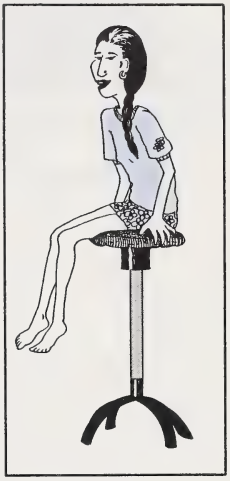
The nervous system controls everything in your body. Visualize it as a huge network of wires and on/off switches with one main computer controlling it all.

1. Name the body's natural computer.

_____

Your nervous system can control your body in three basic ways; sensing, muscle activation, and general body maintenance.

Sit down on any chair or seat high enough for you to have your legs dangle freely from the knee. Make sure that your feet do not touch the floor.



Now have a friend tap you lightly just below your knee.

2. What happens to your lower leg when your friend taps you below the knee?

_____

_____

Nerves make your muscles move.

3. Explain why your lower leg jumps when you are tapped below the knee.

_____

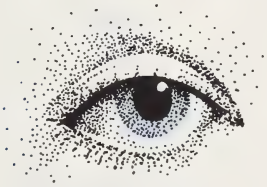
_____

_____

_____

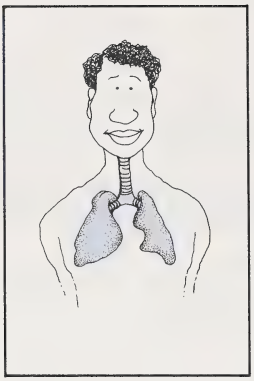
autonomic nervous system - the set of nerves which automatically control body functions such as breathing, heart rate, etc.

This jerking of your knee is part of your autonomic nervous system. It is a set of nerves over which you have no control. This system controls such things as

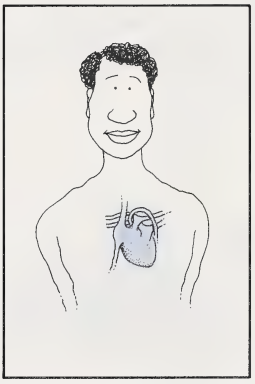


- the size of the pupil

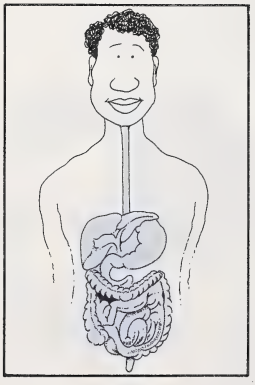
- the production of saliva in your mouth



- breathing rate



- heart rate



- digestion

The autonomic system releases you from having to consciously think about your heart beating or your chest rising and falling when you breathe.

reaction time - the time it takes you to react to a situation

Investigation: Reaction Times

Have you ever tried to catch a housefly in midair with your bare hand? This takes a good deal of hand/eye coordination and quick reactions. The image of the fly is transferred from your eyes to the brain. Your brain then stimulates the nerves which will cause muscles in your arm and hand to contract. If your reactions are good, and the fly is a bit slow, you'll catch the fly!

This investigation compares your reaction time for expected and unexpected events. Complete both parts of this investigation.

Part A: A Control Situation

In this investigation you will decide when to test your reactions.

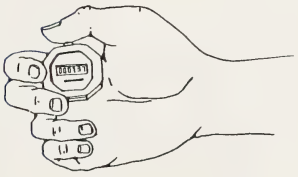
Materials You Need

- a stopwatch or a digital watch with a stopwatch function

Steps to Follow

STEP A

Take your stopwatch and set the time to zero.

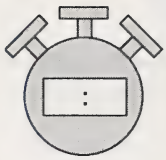


STEP B

Start and stop the watch as fast as you can.

OBSERVATION

Record your reaction time.



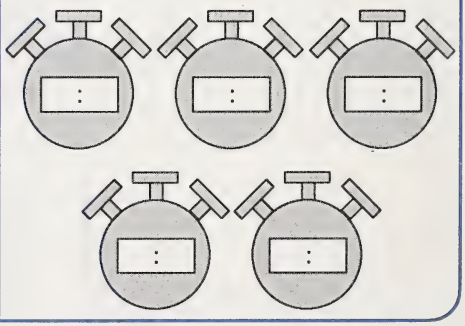
STEP C

Reset the stopwatch to zero and repeat steps A and B five times.

OBSERVATION

Write your reaction times in the stopwatches.

Example: 2:09



control situation - an occurrence in which you control all of the happenings (or variables)

STEP D	OBSERVATION
Determine your average reaction time by adding the numbers from the five stopwatches and dividing by five.	average reaction time = _____ This number is your hand speed reaction time for a **control situation**.

Conclusions

4. Did your reaction times

   _____ increase

   _____ decrease

   _____ stay the same

   Check the correct answer.

5. How could you explain the result in question 4?

   _____

   _____

   _____

Part B: An Unexpected Event

What happens to your reaction time when the situation includes an unexpected event?

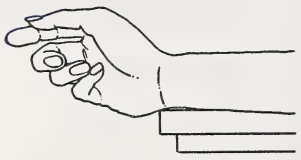
Materials You Need

- a dollar bill (any amount will do; $2,$5,$10, etc.)
  or
- a piece of paper that is cut 15 cm × 7 cm
- a friend

Steps to Follow

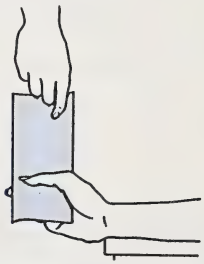
STEP A

Place your hand on the edge of a table. Start with your thumb and forefinger 2.5 cm apart.



STEP B

Have your friend place the bill (paper) between your fingers, and then drop it without giving you any warning.



STEP C

Try to catch the bill between your thumb and forefinger without moving the rest of your hand or arm.

STEP D

Repeat steps A-C ten times.

6. How many times did you catch the bill? _____

Conclusions

This investigation shows that it takes you longer to react to an unexpected event than it takes to react to an expected event. This is due to the many things that must happen before you close your fingers. You must see the bill, know where it is, see your friend drop the bill, realize it is falling, and then finally your brain must stimulate the muscles required to close your fingers. All this thinking takes time, and this time translates into you missing the bill.

Your nervous system also *feels* for you. It senses the environment with a multitude of organs.

7. Match the organs with the functions given on the right.

_____ skin

_____ ear

_____ tongue

_____ eye

a. distinguishes light, dark, and colours and sends the information to the brain

b. detects smells and relays the information to the brain

c. detects heat, cold, pain, and texture and sends the information to the brain

d. detects sweet, salty, sour, and bitter chemicals

e. receives and transmits sound to your brain

_____ nose

Your nervous system is an integral part of your body and is connected to all of your other systems. It keeps your heart beating, sending blood to your tissues and muscles. It gathers information for you to learn. The nervous system can bring about changes in your body functions to prepare you for emergencies. This emergency preparation is called the fight or flight response; either you stand and fight or run in flight.

Check your answers by turning to the Appendix, Section 1: Activity 4.

Activity 5: Feeding the Systems

Cells and the circulatory stystem

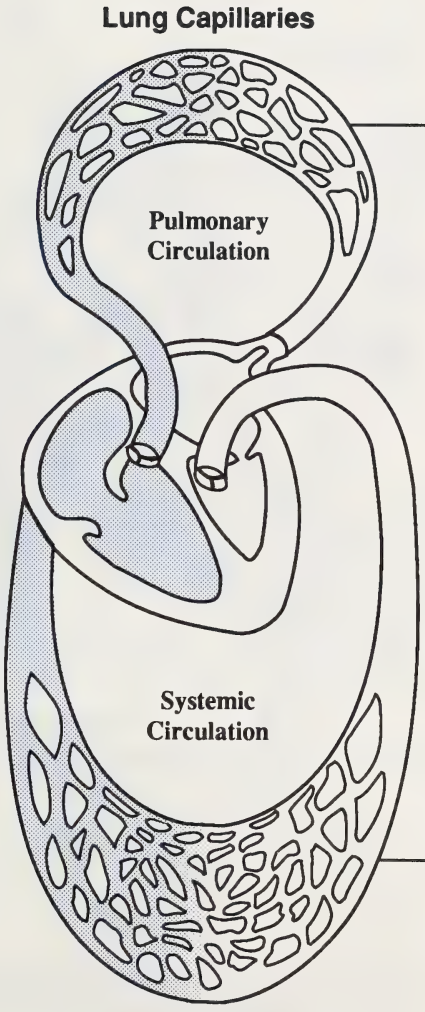
All of your body systems are made up of cells. To function properly, each individual cell must be provided with a constant supply of oxygen and nutrients. Amino acids (A.A.), glucose, and fat are basic nutrients required by all cells.

nutrients - foodstuffs required by the body for energy and the production of cellular materials

Your circulatory system transports oxygen from the lungs and nutrients from the digestive system to all cells. Carbon dioxide and other cellular wastes are carried away from the cells. The constant movement of blood in the circulatory system means that a fresh supply of oxygen and nutrients is always available to your cells. Your circulatory system is really two systems in one. One system, the **pulmonary circuit**, carries blood between the heart and the lungs. The other system, called the **systemic circuit**, carries blood between the heart and the rest of the body.

pulmonary circuit - the part of the circulatory system which passes through the lungs

systemic circuit - the part of the circulatory system which carries blood throughout the body delivering nutrients and oxygen and removing wastes and carbon dioxide



– oxygenated blood, contains ↑ O_2 and ↓ CO_2

– deoxygenated blood; contains ↓ O_2 and ↑ CO_2

Blood picks up oxygen(O_2) in the lungs and gets rid of carbon dioxide (CO_2).

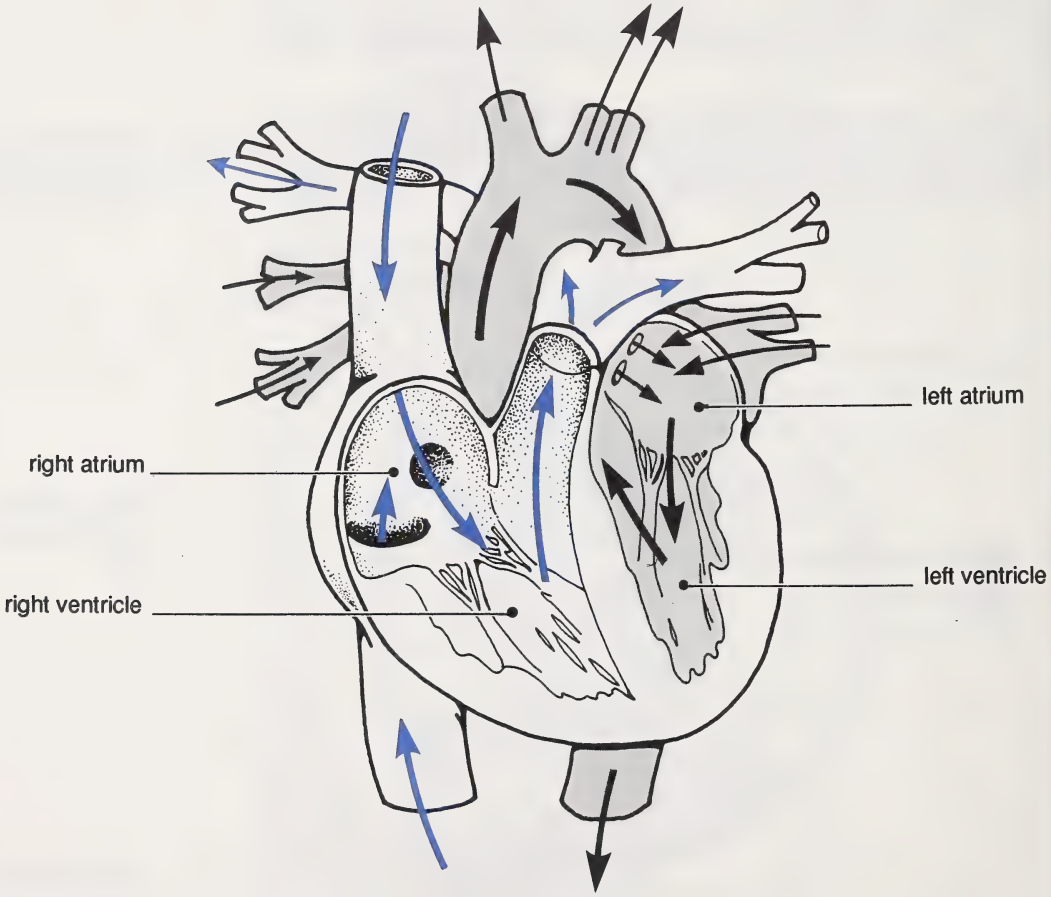
Heart - is always pumping blood to every cell in your body

Capillaries provide individual cells with nutrients and oxygen (O_2); also remove wastes and carbon dioxide (CO_2).

The Heart

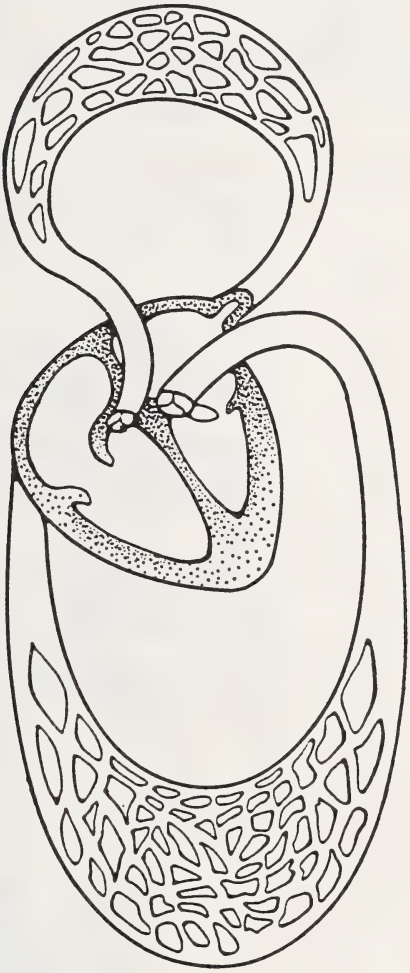
Your heart is constantly working to keep blood flowing throughout the body. Each time your heart beats it pumps 142 mL of blood into circulation. That is 12.5 L a minute or 750 L an hour and 18 000 L every day!

Your heart is actually two separate pumps working together. Each pump is made up of a collecting chamber (the atrium) and a muscular pump (the ventricle).



The right side of your heart collects deoxygenated blood from the body and sends it to the lungs. The left side of the heart receives oxygenated blood from the lungs and pumps it to the rest of the body.

1. Use arrows to indicate the direction of blood flow in the heart and the rest of the circulatory system.



2. It is important that the oxygenated and deoxygenated blood do not mix in the heart.

   Explain why this statement is true.

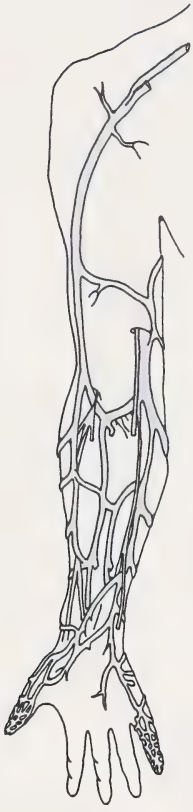
   _____

   _____

   _____

   _____

Blood Vessels



the surface veins on the inside of the right arm

Your circulatory system is made up of three types of blood vessels:

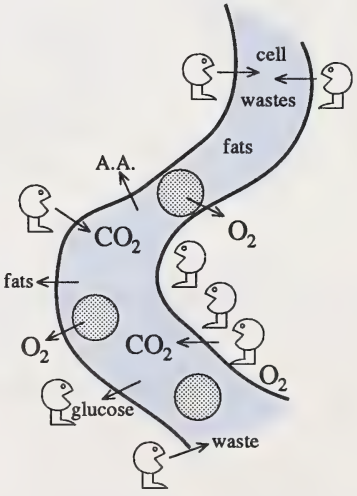
- arteries
- veins
- capillaries

Arteries carry blood away from the heart. Artery walls contain a thick muscular layer of tissue which helps to move blood along. The arteries bulge as blood is forced out of the heart under pressure. As the blood passes, the artery wall springs back helping to move the blood along in the arteries.

Place your right forearm on a flat surface with the palm of your hand facing up. You should be able to see a number of bluish vessels near the surface of your skin. These are the veins of your hand and forearm.

Veins carry blood to the heart. These vessels have thin, less muscular walls because the blood moving through them is under less pressure. Many veins also have built-in valves to prevent the backflow or pooling of blood.

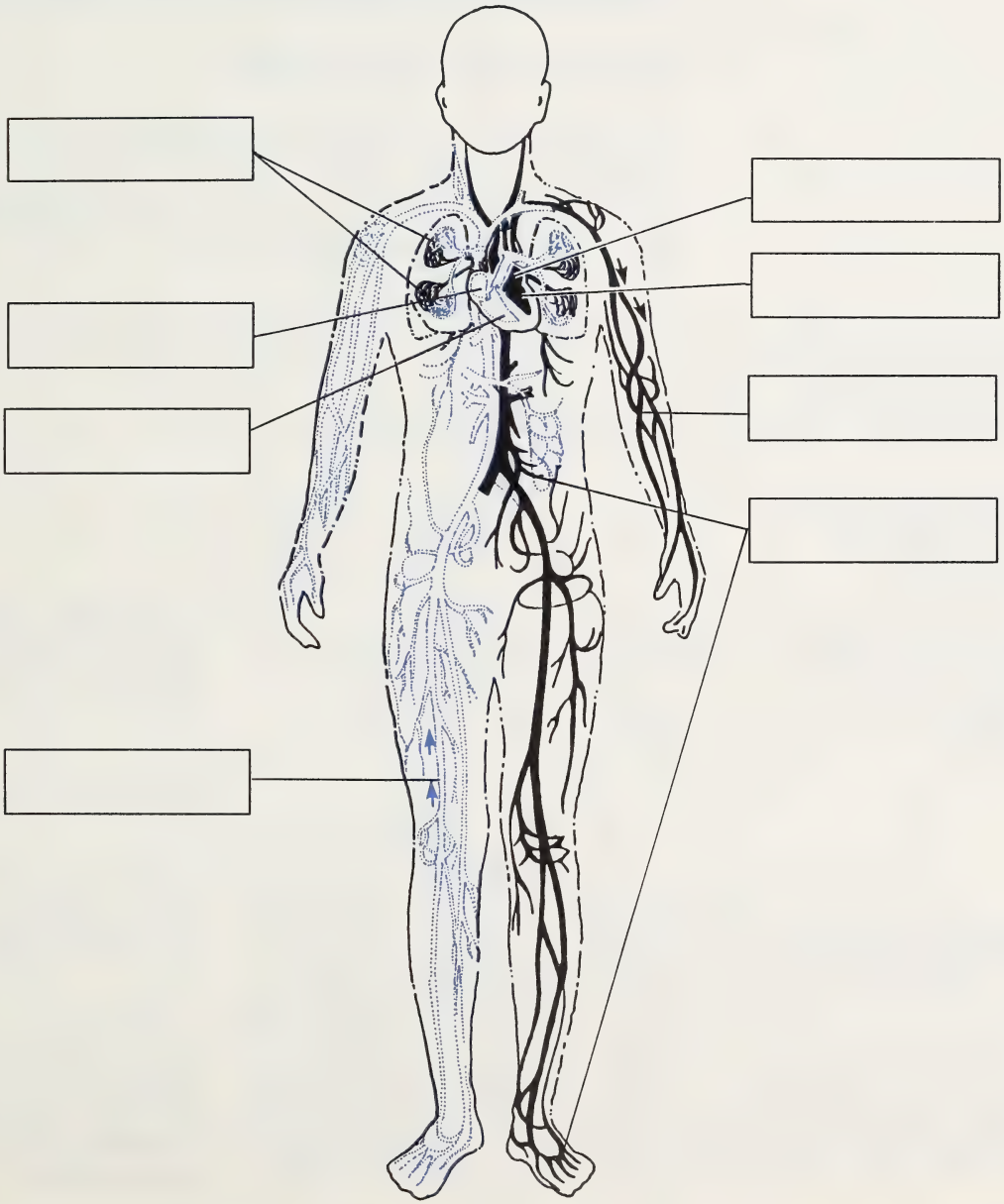
The capillaries are the microscopic vessels which connect the arteries and veins. These vessels are so small that red blood cells are forced to line up in single file when moving through the capillaries. The tiny vessels are necessary to provide every cell in your body with an opportunity to exchange wastes for nutrients and carbon dioxide for oxygen.



Your heart makes sure that the cells of the body have a constant supply of fresh blood. With the powerful pumping action of the heart, blood is able to circulate around your entire body in 90 seconds! Now that's performance!

3. Use the terms provided to label the diagram.

- vein
- artery
- right atrium
- left atrium
- right ventricle
- left ventricle
- pulmonary circuit
- systemic circuit



Looking at the full-figure diagram, you can imagine your body to be a vast and very complex machine that you must strive to take care of. If you take care of your body, your body will take care of you.

Check your answers by turning to the Appendix, Section 1: Activity 5.

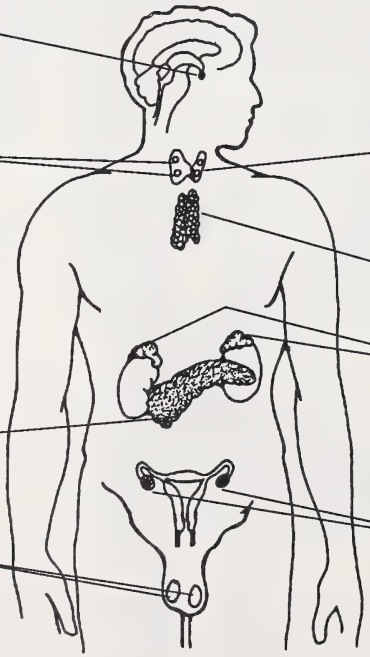
Activity 6: The Helper System

So far in this section you have covered an amazing array of systems that keep you alive and functioning. Keeping you alive and functioning is not an easy task. Everyday you place some sort of stress or strain on your body. A built-in helper system, called the endocrine system, keeps track of all other systems and controls the rate at which they function.

hormone - a chemical usually found in the bloodstream that helps control your body functions

The endocrine system is made up of a set of glands that secrete chemical substances called **hormones** which help keep your body in balance.

Your Endocrine System



pituitary gland – controls the other glands in the endocrine system; the "boss" gland.

parathyroids – regulate the amounts of calcium and phosphorus in the bloodstream

pancreas – controls the blood sugar levels in the bloodstream

testes (in male) – produce sperm for reproduction and develops male secondary sex characteristics

thyroid gland – regulates growth and metabolism; can speed up or slow down digestion.

thymus – assists in protecting your body against disease

– provide energy in emergency situations and help the body to adapt to stress and strain

ovaries (in female) – produce eggs for reproduction and develops female secondary sex characteristics Also maintains pregnancy and aids in childbirth.

1. a. Which glands are needed when you get into an emergency situation?

_____

b. What do these glands do in an emergency?

_____

_____

_____

_____

2. Name the appropriate reproductive glands and explain their function.

a. male:

_____

_____

_____

_____

_____

b. female:

_____

_____

_____

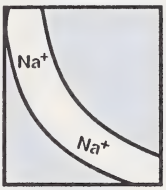
_____

_____

Hormones are released by your endocrine glands directly into the bloodstream. Once they are in the bloodstream, hormones are able to reach almost every cell in the body. No hormone will affect all of the cells that it comes in contact with. Each hormone only affects a certain kind of cell which is found in the target organ. The cells of the target organ will respond to the hormone in a predetermined manner.

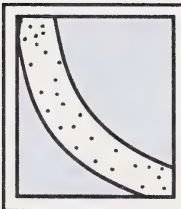
Some hormones have more than one target organ, affecting whole body systems in some way. The following example shows how the adrenal gland controls the sodium level of the blood by using the kidney as its target organ.

The adrenal gland constantly monitors the level of sodium in your blood.

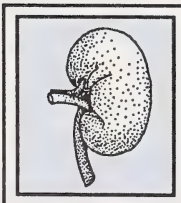


Low levels of sodium (Na+) in the blood.

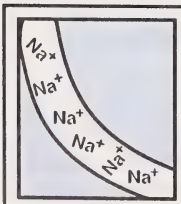
The adrenal gland releases more aldosterone.



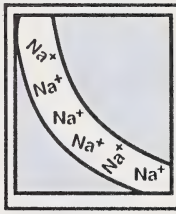
Aldosterone moves through the blood affecting only the target organ, the kidney.



Kidney responds to more aldosterone by returning more sodium to the blood.

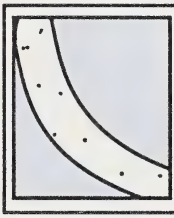


Sodium levels in the blood increase.

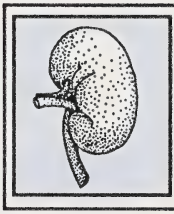


High levels of sodium (Na+) in the blood.

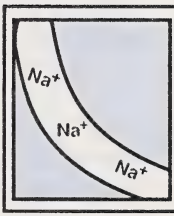
The adrenal gland reduces the secretion of aldosterone.



Levels of aldosterone in the bloodstream are reduced.



With less aldosterone, the kidney releases more sodium to the urine, less sodium is returned to the blood.



Sodium levels in the blood decrease.

Notice that the adrenal gland maintains a balance of sodium in the blood. This gland automatically sees to it that you always have just the right amount of sodium in your blood, never too much or too little.

The pancreas secretes two hormones which control your blood sugar level (the amount of glucose in your bloodstream). These hormones are insulin and glucagon. When the blood sugar levels are low, glucagon stimulates the liver to release more glucose into the blood stream. If blood sugar levels are high, the pancreas secretes insulin into the bloodstream causing the liver to withdraw glucose from the blood.

3. Name the two hormones secreted by the pancreas.

_____

_____

4. What is the target organ for insulin?

_____

5. Which hormone would be released by your pancreas after you have just eaten a chocolate bar and consumed a soft drink? Explain why you would choose this hormone.

_____

_____

_____

_____

Check your answers by turning to the Appendix, Section 1: Activity 6.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

Extra Help

The following is a list of terms that you should know. Review the activities in Section 1 to find the meaning or function for each of these words.

digestive system: _____

_____

_____

hypothesis: _____

_____

organ: _____

_____

mouth: _____

_____

esophagus: _____

_____

small intestine: _____

_____

_____

compact bone: _____

_____

articulation: _____

_____

_____

spongy bone: _____

_____

reaction time: _____

_____

autonomic nervous system: _____

_____

_____

artery: _____

_____

vein: _____

_____

Check your answers by turning to the Appendix, Section 1: Extra Help.

Enrichment

Complete any or all of the following.

1. Plan a complete physical checkup with your doctor. Ask the doctor about each system in your body and which test they use to find out if it is functioning properly.

2. Write a short research paper on the system that interested you the most.

3. Create a web diagram showing how each system helps or is helped by your other systems.

Share you answers with your learning facilitator.

Conclusion

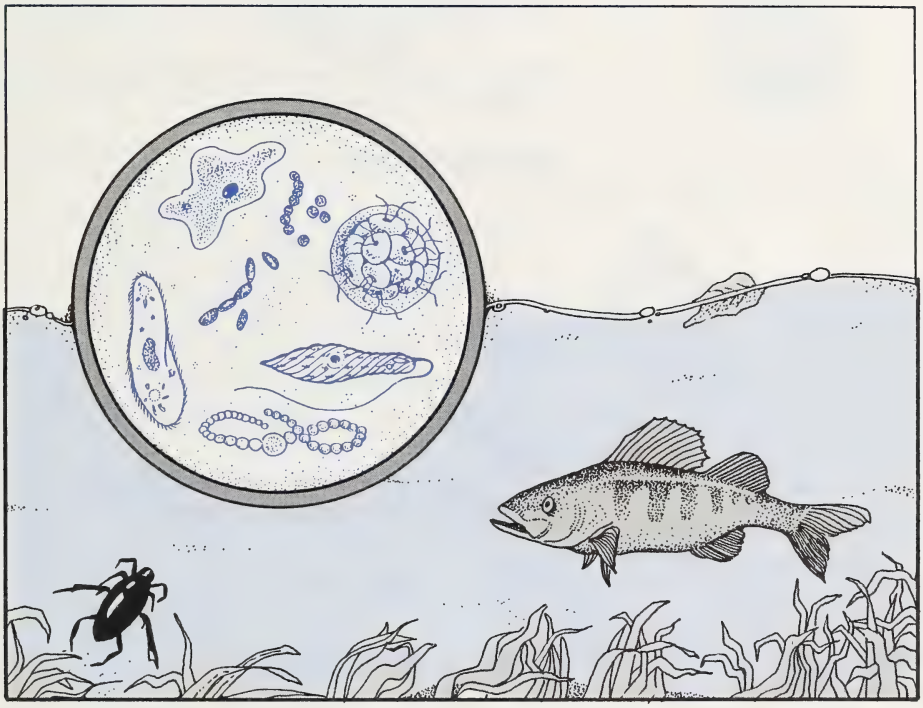
Your body is a combination of many different systems. Each system does its best to keep you fit and alive. Now that you know what each of your systems does, try thinking of your body in its entirety – each system meshing and synchronizing with the other systems. Since food is essential to all life, start with your digestive system. This system provides the fuel required by all of your other systems. Your digestive system is held in place by your skeleton, which in turn is being moved by your muscle system. Your muscles only move if stimulated by your brain and nerves. The circulatory system carries nutrients from the digestive system to the rest of the body. Remember, your body is not just one entity, but rather the successful combination of many parts to make a healthy whole you!

Assignment Booklet

ASSIGNMENT

Turn to your Assignment Booklet and do the assignment for Section 1.

2 It's a Small World



Have you ever taken a close look at the tiny organisms swimming about in water taken from a pond or lake? You should have seen diving beetles, mosquito larvae, and tiny freshwater crustaceans such as *Daphnia* and fairy shrimp. Did you know that the water also contains millions of organisms too small for the eye to see? The development of the microscope has enabled humans to see and understand the microscopic organisms found in this world. In this section you will make and use a primitive microscope. You will also study the *Paramecium*, a common micro-organism, to see how it performs all of the functions necessary for life.

Activity 1: The Microscope

microscope - an instrument that uses lenses to produce an enlarged or magnified image of small objects

The **microscope** allows you to see some of the organisms which are invisible to the naked eye. A microscope consists of two convex lenses, carefully aligned to magnify the object being looked at. You can construct your own simple microscope with only a minimum amount of materials.

Complete Part A only if you are not able to use a compound microscope. Complete Part B if you do have access to a compound microscope.

Part A

Investigation: A Homemade Microscope

In this investigation you will examine various items using a simple microscope that **you** put together.

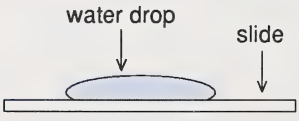
Materials You Need

- water
- a glass slide
- magnifying lens

Steps to Follow

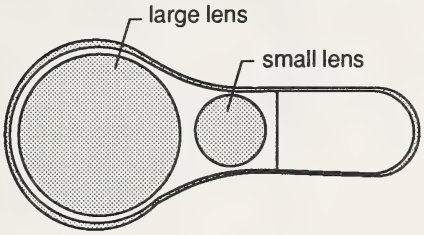
STEP A

Place a large drop of water on the glass slide so that it makes a small bubble.



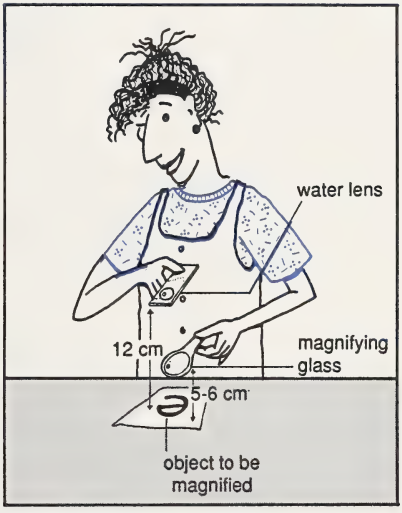
The bubble of water creates a water lens that will be used as the top lens of the microscope.

The smaller magnifying lens should be used as the lower lens of the microscope.



STEP B

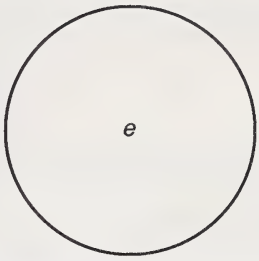
Hold the magnifying lens in your lower hand and the water lens in your upper hand. Line up the lenses over the object to be magnified (the printed letter shown in step C).



STEP C

Hold the small magnifying lens 5 to 6 cm above the letter *e*. Next, position the water lens about 12 cm above the magnifying lens, moving slightly up or down to focus the *e* image.

Test Image



1. What happens to the letter *e* when you look at it through the lenses?

_____

_____

_____

_____

2. Turn this page upside down and look at the print through your microscope. Describe what you see.

_____

_____

_____

Check your answers by turning to the Appendix, Section 2: Activity 1.

Part B

Investigation: Use and Care of the Compound Microscope

A microscope is an instrument used to study objects too small to be seen clearly by the unaided eye. All students should be able to operate a microscope, since many of the things you will study in science cannot be seen without magnification. In this exercise you will

- learn the parts of the microscope and how they function
- learn how to handle and care for a microscope
- learn how to handle and clean microscope slides and cover slips
- learn how to make a wet mount

Materials You Need

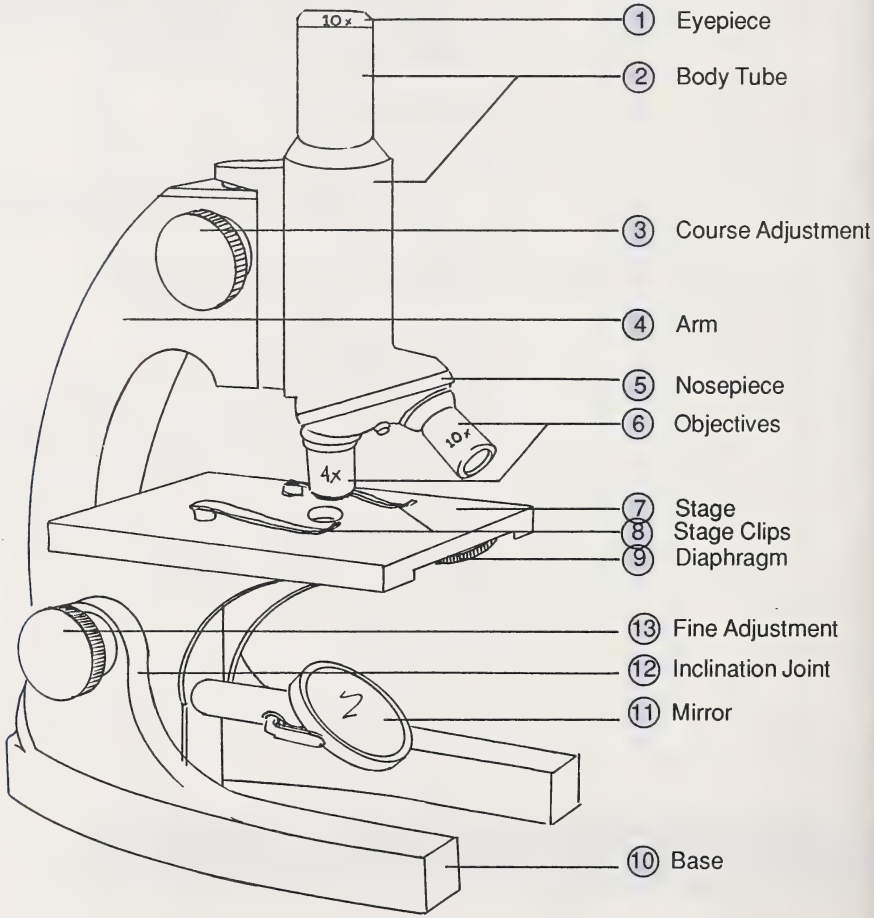
- a compound microscope
  School students must make arrangements to use a microscope from their school.
- microscope slides and cover slips
- lens paper
- a piece of a newspaper containing the lower case letter *e*
- a soft lint-free piece of cloth or paper towel
- a medicine dropper
- tweezers
- scissors

Steps to Follow

STEP A

The Parts of the Compound Microscope

Take a look at the following diagram of a generalized compound microscope. Familiarize yourself with the names and functions of each part.



Note: Not all microscopes are the same. Obtain a compound microscope from your learning facilitator. Remove the microscope from its storage case; carry it by the arm with one hand and support it by the base with the open palm of your other hand. Place it on the work area in front of you so that you can compare it to the diagram and the descriptions of the parts.

(1) **Eyepiece** – The eyepiece contains one of the lenses that magnifies the object being looked at. Usually there is a number stamped on it (e.g. 10X) to indicate the lens' magnifying power. You look through the eyepiece to see objects mounted on slides that are put on the surface of the stage.

Some eyepieces are fixed, others are removable so they can be replaced with others of lower or higher magnification. On a few microscopes the eyepiece may have a zoom feature that allows you to change magnification by simply turning the eyepiece. Usually the zoom magnifications are stamped on the eyepiece (e.g. 5-15X).

(2) **Body Tube** – The body tube holds the lenses of the eyepiece and objectives at the correct distances from each other.

(3) **Coarse Adjustment** – This knob is turned to move the body tube up and down in order to focus on the specimen mounted on the stage.

(4) **Arm** – It supports the body tube and coarse adjustment.

(5) **Nosepiece** – This structure rotates the objectives, lining them up with the body tube. Changing the objectives will give you different magnifications. On microscopes with only one objective, no nosepiece will be present; the single objective is fixed directly at the base of the body tube.

(6) **Objectives** – These structures hold lenses for different magnifications. Usually there is a number stamped on the side of each objective stating its magnification. The shortest objective has the lowest magnification (e.g. 4X), and the longest objective will have the highest magnification (e.g. 20X). The total magification can be found by multiplying the number on the eyepiece by the number on the objective. Some microscopes will have a third objective with a level of magnification somewhere between that of the high and low power objectives.

(7) **Stage** –The stage is a platform on which your slides are placed. Objects mounted on a slide can be viewed by positioning them over the hole in the stage. The hole in the stage allows light reflected from the mirror to pass by and through the object being viewed. The light then passes through the lenses of the objective and the eyepiece to reach your eye.

(8) **Stage Clips** –These hold the slide in position on the stage. The clips are placed on top of the slide to hold it in position.

(9) **Diaphragm** –This part of the microscope controls the amount of light passing through your specimen. There are two types of diaphragms. The **disk diaphragm** is a round disk just beneath the stage. It has a series of holes progressing from small to large that can be rotated into position beneath the hole in the stage. The **iris diaphragm** is more complex. It is cylindrically shaped and varies the amount of light reaching the stage. By moving a lever on the outside of the cylinder the size of the hole in the diaphragm is varied.

(10) **Base** – The base supports all parts of the microscope.

(11) **Mirror** – The mirror is used to gather and focus light up through the diaphragm, stage, slide, objective, and eyepiece. Daylight can be used as a source of light. On dark days or in the evening, use a table lamp. Some of the more expensive microscopes come with their own built-in light source.

Caution: Never aim your mirror directly at the sun as magnified sunlight can damage your eye.

(12) **Inclination Joint** – This permits the body of the microscope to be tilted backwards. The microscope should generally be kept in an upright position but may be tilted back if this allows for a better view through the eyepiece. Always return a microscope to its upright position when moving it or storing it.

(13) **Fine Adjustment** – The fine adjustment is rotated to move the body tube up or down very slightly thus making exact focussing much easier. Not all microscopes have a fine focus. Sometimes the fine focus is found in conjunction with the coarse focus, one being the outer knob and the other a smaller inner knob.

3. Identify the part of the compound microscope which performs each of the following functions.

   a. holds down a slide: _____

   b. keeps the lenses of the microscope the correct distance apart:

   _____

   c. holds the lower lens of the compound microscope:

   _____

   d. controls the amount of light which passes through the object being examined: _____

STEP B

Setting Up Your Microscope

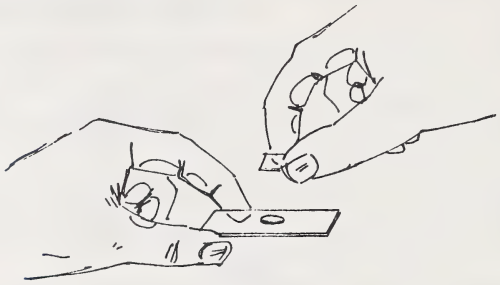
- Place the compound microscope on a table in front of you with the arm towards you and the stage away from you.
- Turn the nose piece until the low power (shortest) objective clicks into position directly below the body tube.
- Adjust the mirror by looking through the eyepiece and moving the mirror around until it reflects the maximum amount of light. The **field of view** should be evenly illuminated. If your microscope has a light source, simply plug it in and turn it on.
- The diaphragm must be adjusted to eliminate glare or to provide more light. On a disk diaphragm rotate the disk until the right-sized hole clicks into position. Check the light level by looking through the eyepiece. On an iris diaphragm move the lever to obtain a suitable light level. Again check the light level looking through the eyepiece.
- If the lenses of the eyepiece or objective are dirty or dusty they should be cleaned. Wipe them clean with lens paper. Do not use anything else to clean lenses as they are easily scratched. Lens paper should also be used to clean the mirror if necessary. Use a piece of lens paper only once; then throw it away.

field of view – the area that you see through the microscope

STEP C

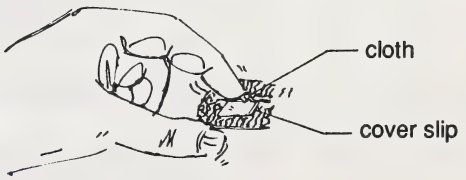
Preparing Materials for the Microscope

Most materials viewed under a microscope are placed on a glass microscope slide that is then covered with a thin square cover slip. Be extra careful when handling cover slips as they break very easily. Always handle slides and cover slips by their edges so that you won't get fingerprints or dirt on them.



Always handle slides and cover slips by their edges.

If your cover slip and microscope slide are not perfectly clean, you should wash them in warm soapy water. Dry them with a soft lint-free piece of cloth; then lean them against a book or some other object until you are ready to use them. Be particularly careful when cleaning the cover slip. Place it between a fold of cloth then simulaneously clean both sides by putting the cover slip and cloth between your thumb and index finger. Apply pressure to both surfaces of the cover slip while cleaning and drying.

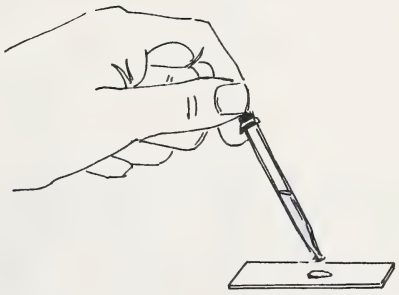


Drying a Cover Slip

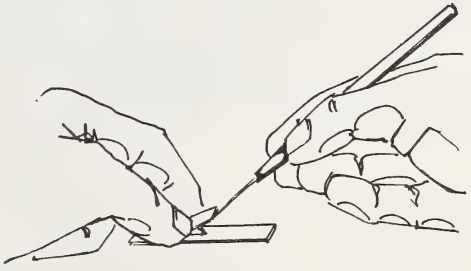
STEP C

Continuing to Prepare Materials for the Microscope

You are now going to mount some newsprint on a clean slide. Get a piece of newspaper that has a lower case letter *e* printed on it. With a pair of scissors cut out a 1 cm square piece of newspaper containing the letter *e*. Place your microscope slide on a clean piece of paper towel. Using tweezers, place the 1 cm square piece of newspaper in the centre of the slide with the print side up. Use your medicine dropper to add one drop of water to the newspaper.



Wait a few seconds for the water to soak in; then add your cover slip. The best way to put on the cover slip without trapping air bubbles in the water between the slide and cover slip is to hold the cover slip at a 45° angle above the water droplet and slowly lower it using a dissecting needle, pencil, or tweeezers until it lies flat on the slide over the water drop.

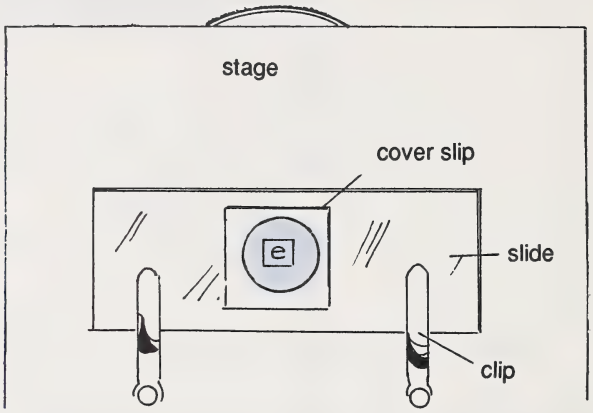


If any air bubbles form these can usually be removed by gently tapping the cover slip with the eraser end of your pencil. The slide you have produced is what is known as a **wet mount**.

STEP D

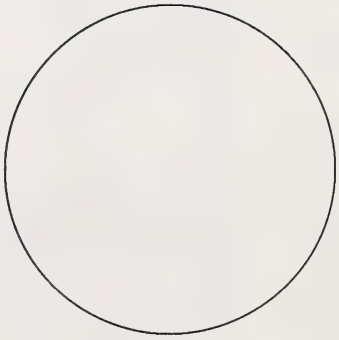
How to View the Slide

Place your slide on the stage of the microscope and centre the letter *e* over the opening in the stage. The letter *e* should face you as it does on this page, not upside down. Put the stage clips on the slide to hold it in position.



Make sure that the low power objective is in line with the eyepiece and body tube of the microscope. Use the course adjustment knob to bring the letter *e* into focus. The fine adjustment can be used to give you the clearest image.

4. In the following circle, draw the letter *e* as it appears through your microscope.



5. Observe the letter *e* through the eyepiece and slowly move the slide to the right. When you do this, in which direction does the image seen through the eyepiece appear to move?

_____

_____

6. Centre the letter *e* in the field of view again. Now try moving the letter *e* away from you. In which direction does the image seen through the eyepiece move?

_____

_____

In order to view an object at high power (longest objective), centre the object to be viewed (in this case the letter *e*) in the field of view at low power. Hold it in this position with the stage clips. Next, raise the body tube and switch to the high power objective. This must be done to ensure that the lens of the high power objective does not come in contact with the slide and cover slip. Once in position, watching very carefully from the side of the microscope, lower the body tube until the lens of the high power objective is just above the surface of the cover slip of the slide. Now you can look through the eyepiece and focus in on the object by very slowly raising the body tube.

Note: Never focus on an object at high power by lowering the body tube as you may ram the lens of the objective into the slide and cover slip thus damaging both. If you miss your focus on the letter *e*, repeat this procedure until you get it. Answer the following questions.

7. a. When the letter *e* is viewed at high power is the field of view (the area of the object that you can see) larger or smaller than at low power?

_____

_____

b. Does the brightness of the image seen through the microscope change when you switch from low power to high power?

_____

_____

8. Can you see the entire letter *e* when looking at it through the high power objective?

_____

Explain why or why not.

_____

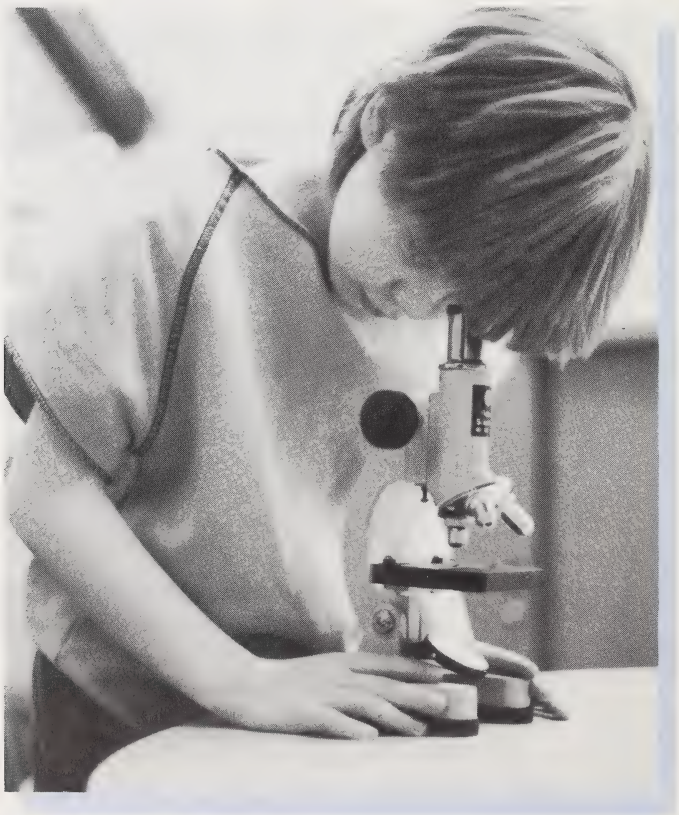
_____

_____

_____

_____

Check your answers by turning to the Appendix, Section 2: Activity 1.



STEP E

Care of the Microscope

- When using a microscope, always keep it 5 to 10 cm away from the table's edge to prevent accidentally knocking it to the ground.
- To prevent damage to the lenses never focus by moving the body tube downward. This will prevent ramming the objective into the slide.
- Lenses should only be cleaned using lens paper. Once you have used a piece of lens paper, discard it.
- A microscope should always be carried by its arm with the base supported by your other hand.
- Don't tilt a microscope at its inclination joint unless absolutely necessary. This makes the microscope less stable and more likely to fall over. Also, if tilted the cover slip and the water of a wet mount will run off the slide onto the stage.
- Before storing a microscope the following steps should be taken:
  - Remove all slides and clean the slides and cover slips.
  - Straighten the microscope if tilted at the inclination joint.
  - Clean the lenses with lens paper if necessary.
  - Make sure the stage clips do not extend from the sides of the stage.
  - Turn the low power objective into position and adjust the body tube so the objective lens is roughly 1 cm above the stage.
  - Place the microscope in its storage case and put it in a safe place.

Scientists have been using the microscope to learn more about the invisible world around you for over 300 years. In 1655, Robert Hooke used a compound microscope to describe dead cork cells, and in 1674, Anton van Leeuwenhoek became the first to examine living single-celled organisms. Scientists have been constantly improving the microscope in order to learn more about life in the *small world.*

Anton van Leeuwenhoek observing micro-organisms with his microscope.

Activity 2: Life in a Small Package

The microscope was used to reveal the existence of one-celled organisms. These organisms are so small that millions of them can live quite comfortably in a small puddle in your backyard. One of the most commonly studied single-celled organisms is the *Paramecium*. It is important for you to understand that a *Paramecium* must do all the things that your body systems do to stay alive.

Paramecium - a single-celled organism that uses cilia to gather food and to move from one place to another

There must be some sort of system in every organism that carries out the functions that your body does.

1. List your six important body systems.

_____

_____

_____

_____

Some animals, like the frog, have body systems that are similar to yours, but what about a single-celled organism such as the *Paramecium*? How does a *Paramecium* get all of these complex systems into one small cell? Improvements in the microscope's design have given us the tools that can see inside a living *Paramecium* where the vital functions occur.
Look at the *Paramecia* on the following pages and complete the exercise for each function.

Digestion in the *Paramecium*

organelle - a specialized part of a cell that carries out a required function

2. Match the function with the digestive **organelles** labelled in the *Paramecium* diagram.

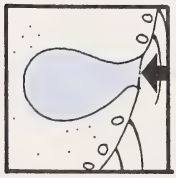
oral groove - an opening that leads to the mouth

mouth - an opening where food is taken into the organism

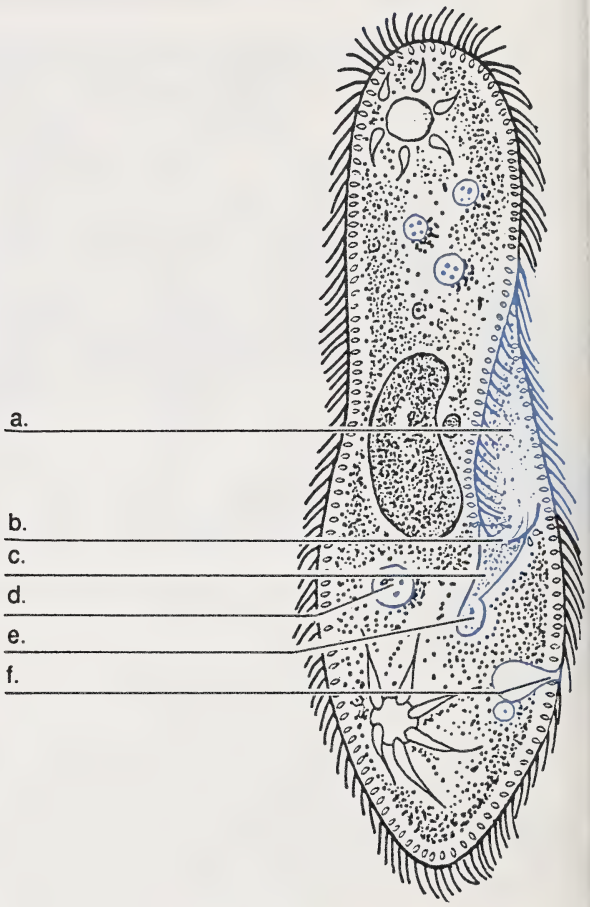
gullet - a passageway for food

food vacuole - a site for the storage and digestion of food

forming food vacuole - located at the bottom of the gullet, food vacuoles fill and break off to travel throughout the organism



anal pore - the opening through which wastes are expelled from the organism

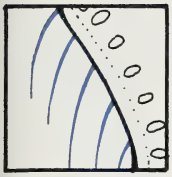


Check your answers by turning to the Appendix, Section 2: Activity 2.

Nervous System of the *Paramecium*

There is no real set of nerves in a *Paramecium*, but there are structures that do allow the *Paramecium* to sense its environment and control its internal systems.

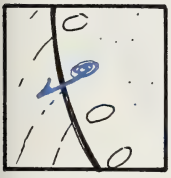
3. Match the function with the organelles labeled in the *Paramecium* diagram.



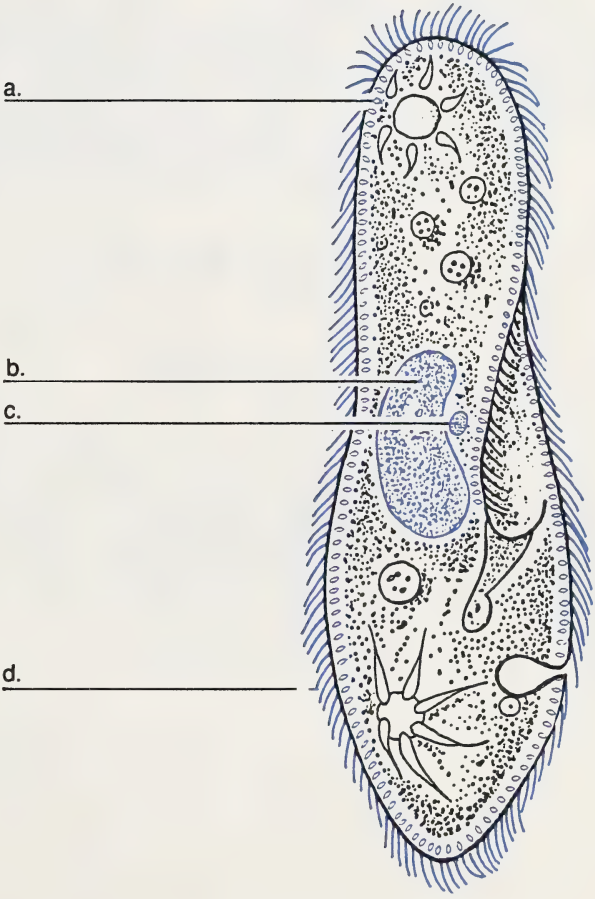
cillia - hair-like structures that sense the environment through touch

macronucleus - the organelle which controls and regulates the day-to-day activities of the cell; much like the human brain

micronucleus - the organelle which helps the macronucleus in its activity

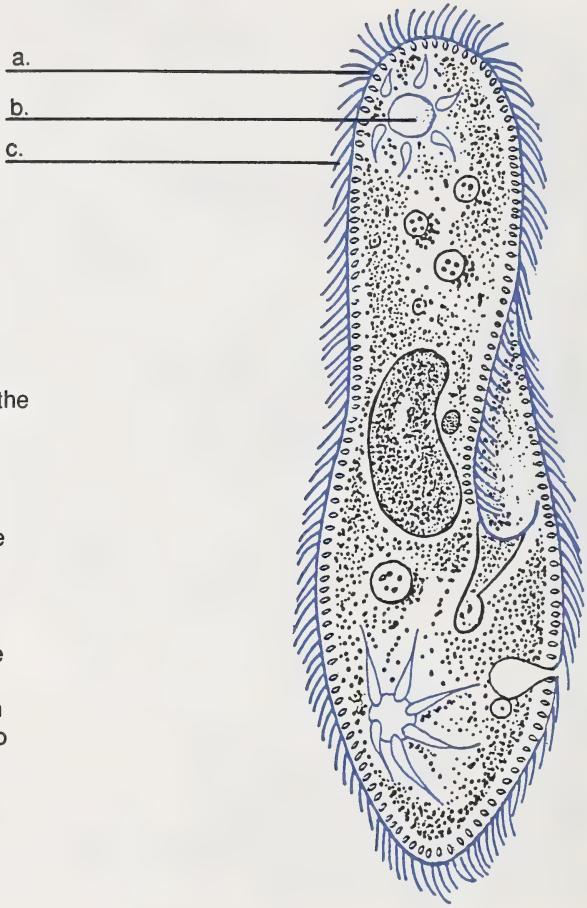


trichocysts - tiny barbs coiled up in small sacks which can be discharged like harpoons when the *Paramecium* is threatened; the same as fight or flight system in humans



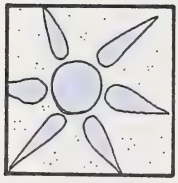
Skeletal, Muscular, and Excretory System of the *Paramecium*

4. Match the functions with the organelles labelled in the *Paramecium* diagram.



pellicle - a thick wall around the outside of a *Paramecium* that gives it a shape

cilia - movable hairs that provide the locomotion for the *Paramecium*

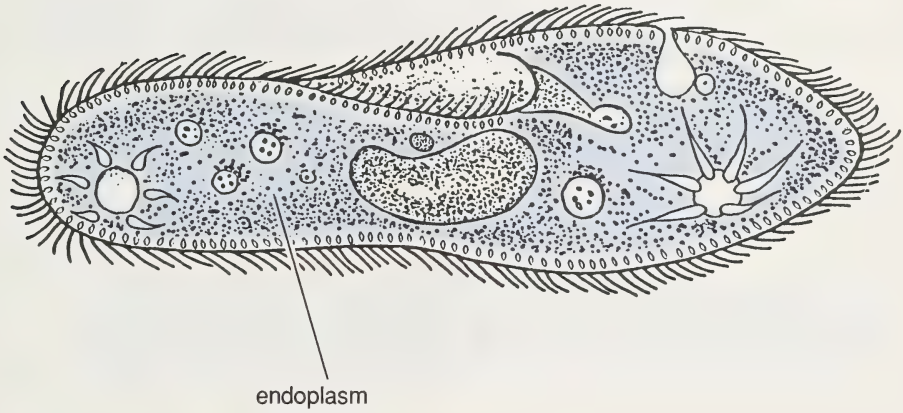


contractile vacuole - a large storage sack that fills with excess water in the organism and contracts like a muscle to expel the water out. This organelle functions like the kidney in higher organisms.

Check your answers by turning to the Appendix, Section 2: Activity 2.

Circulatory and Endocrine System of the *Paramecium*

There is no real hormonal system in a one-celled organism because it is too small to really need one. Single-celled organisms do not have blood vessels or a heart like you have in your body for circulation. The *Paramecium* has a fluid called **endoplasm** (cytoplasm) that circulates throughout the entire organism, providing the nutrients it needs to survive.



Most of your knowledge of yourself and the world around you has been discovered by persevering scientists such as Robert Hooke and Anton van Leeuwenhoek. Without the discovery of the microscope, the miraculous world of the *Paramecium,* and even the world within your own cells, would not be known. Many of the world's great discoveries have been the result of some sort of technology. With science and technology, people can better understand their bodies and the diseases that infect them.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

Extra Help

The following is a list of terms that you should know. Review the activities in Section 2 to find the meaning or function for each of these words.

microscope: _____

_____

_____

***Paramecium*:** _____

_____

_____

organelle: _____

_____

_____

food vacuole: _____

_____

_____

macronucleus: _____

_____

_____

cilia: _____

_____

_____

pellicle: _____

_____

_____

contractile vacuole: _____

_____

_____

endoplasm: _____

_____

_____

Check your answers by turning to the Appendix, Section 2: Extra Help.

Enrichment

Complete one of the following.

1. Obtain a microscope and use it to examine five household items. Diagram and describe what you see. Items that you may want to look at are salt, sugar, thread, flour, leaves, grass, human hair, and a small insect.

2. Use your homemade microscope to examine five household items. Diagram and describe what you see.

Share your observations with your learning facilitator.

Conclusion

Technology and all of its advancements have a profound effect on your daily life. With every new discovery or development comes new and exciting things to research and understand about yourself. The quality of life and the health you enjoy is due to men and women studying the human body and the microscopic world.

ASSIGNMENT

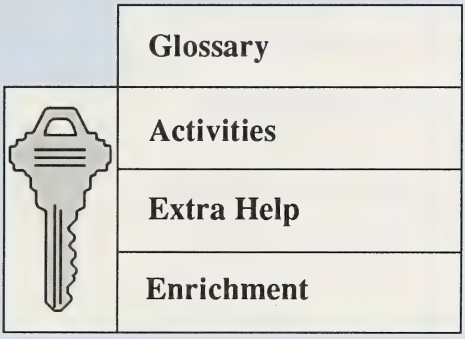
Turn to your Assignment Booklet and do the assignment for Section 2.

MODULE SUMMARY

Much of what is known about people has to be learned by studying lower forms of life. Technology and its advancements have made possible the study of organisms too small to be seen by the naked eye. Advancements in microscope design have allowed scientists to study the structure and function of cellular organelles.

You should now be able to list the six common body systems, name the essential organs, and describe how each system works to keep you healthy and alive.

Appendix



Glossary

Adrenal glands
- glands which provide energy in emergency situations and help the body adapt to stress and strain

Anal pore
- the opening through which wastes are expelled from the *Paramecium*

Anus
- an opening, usually at the rear of an animal, through which indigestible material is excreted or gotten rid of

Artery
- a vessel that carries blood away from the heart

Articulation
- the point where two bones meet
  Usually some sort of bending occurs at a joint or articulation.

Autonomic nervous system
- the set of nerves which autonomically control body functions such as breathing, heart rate, etc.

Bile duct
- a thin tube through which bile is taken from the gallbladder to the small intestine

Capillaries
- very small blood vessels which supply individual cells with nutrients and oxygen and remove wastes and carbon dioxide

Cartilage
- a smooth, rubbery substance that acts as a shock absorber for your joints

Cilia
- hair-like structures which wave to move the *Paramecium* and to move food into the mouth and gullet
  The cilia also provide a sense of touch for the *Paramecium*.

Cloaca
- the passageway in the frog for wastes to the anus

Compact bone
- hard, dense bone made of calcium and fibres

Contractile vacuole
- the organelle which collects and expels excess water out of the organism

Control situation
- an occurrence in which you control all of the variables or happenings

Crop
- a sack that stores food before digestion begins

Digestive system
- the system within the body which converts food to fuel and raw materials that can be used by the body

Endoplasm
- the fluid that circulates within a cell or single-celled organism to provide the nutrients needed by all organelles

Esophagus
- a muscular tube that moves food toward the stomach or crop

Field of view
- the area that you see through the microscope

Food vacuole
- the site for the storage and digestion of food

Forming food vacuole
- a food vacuole located at the bottom of the gullet which fills and breaks off to travel throughout the *Paramecium*

Gallbladder
- a storage sack for bile

Gizzard
- a muscular sack that starts digestion by breaking down food into smaller particles by grinding it with sand or rock

Gullet
- a passageway for food in the *Paramecium*

Heart
- the organ which pumps blood to all parts of the body

Hormone
- a chemical usually found in the bloodstream that helps control your body functions

Hypothesis
- an educated guess or best estimate; what you think the correct answer is

Large intestine
- a short tube where water is absorbed
  Vitamins are made here by special bacteria which live in the intestine. The large intestine does the final processing of wastes.

Ligament
- a tough band of tissue that connects or holds your bones in place

Liver
- secretes a digestive juice called bile which aids in the breaking down of fats
  It also stores a quick energy source for the body called glycogen (a simple sugar used for emergency energy), as well as vitamins A, D, E, and K

Macronucleus
- the organelle which controls and regulates the day-to-day activities of the *Paramecium*

Marrow
- a material found within the spaces and somtimes in the centre of a bone; produces red and white blood cells

Mesentery
- thin bands or sheets of tissue that hold your intestines and other organs in place

Micronucleus
- the organelle which assists the macronucleus in carrying out its activities

Microscope
- an instrument that uses lenses to produce an enlarged or magnified image of small objects

Mouth
- the opening where food is taken into the organism

Nutrients
- foodstuffs required by the body for energy and the production of cellular materials

Oral groove
- an opening that leads to the mouth of the *Paramecium*

Organ
- a body part or group of tissues that performs a specific function for the body

Organelle
- a specialized part of a cell that carries out a required function

Ovaries
- the female organ of reproduction; also responsible for the development of female secondary sex characteristics and maintaining pregnancy

Pancreas
- an organ that secretes juices into the small intestine to increase digestion; also controls blood sugar level

Paramecium
- a single-celled organism that uses cilia to gather food and to move from one place to another

Parathyroids
- glands which regulate the amounts of calcium and phosphorus in the bloodstream

Pellicle
- the thick outer wall that gives the *Paramecium* its shape

Pharynx
- a muscular tube that draws in food

Pituitary
- the master gland which controls the other glands in the endocrine system

Pulmonary circuit
- the part of the circulatory system which passes through the lungs; as blood passes through the pulmonary circuit it picks up oxygen and rids itself of carbon dioxide and other wastes

Reaction time
- the time it takes you to react to a situation

Rectum
- the last part of the large intestine; temporarily stores wastes; also aids in moving wastes out of the body

Salivary glands
- produce saliva, a mild digestive juice that begins the digestive process in the mouth

Secrete
- to release a useful substance such as a hormone

Small intestine
- a long tube where absorption of nutrients occurs
  Chemicals are released by the small intestine that break down food particles into smaller pieces that can easily by carried by the blood to the rest of the body.

Spleen
- the organ which produces and stores red blood cells for the circulatory system and provides iron, one of the building blocks of bile, to the liver

Spongy bone
- a type of bone made of calcium, containing many narrow spaces which give it a sponge-like appearance

Stomach
- a large holding sack
  Chemical digestion starts here by using acid to break down food. The stomach also regulates the amount of food allowed into the small intestine.

Systematic circuit
- the part of the circulatory system that carries blood throughout the body delivering nutrients and oxygen and removing wastes and carbon dioxide

Testes
- the male organ of reproduction; also responsible for the development of male secondary sex characteristics

Thymus
- a gland which assists in protecting your body against disease

Thyroid
- a gland which regulates growth and metabolism

Tongue
- used to push food back into the gullet or pharynx to permit swallowing

Trichocysts
- tiny barbs coiled up in small sacks which can be discharged like a harpoon when the *Paramecium* is threatened

Vein
- a vessel that carries blood to the heart

Suggested Answers

Section 1: Activity 1

1. No, the digestive systems would not be the same because

   - the animals are different sizes
   - the animals belong to different species
   - they possess different levels of complexity
   - the animals all eat different foods

2. The digestive system of the earthworm is quite simple. Food goes in the mouth and waste is excreted through the anus. Most of the actual digestion and absorption occurs in the small intestine.

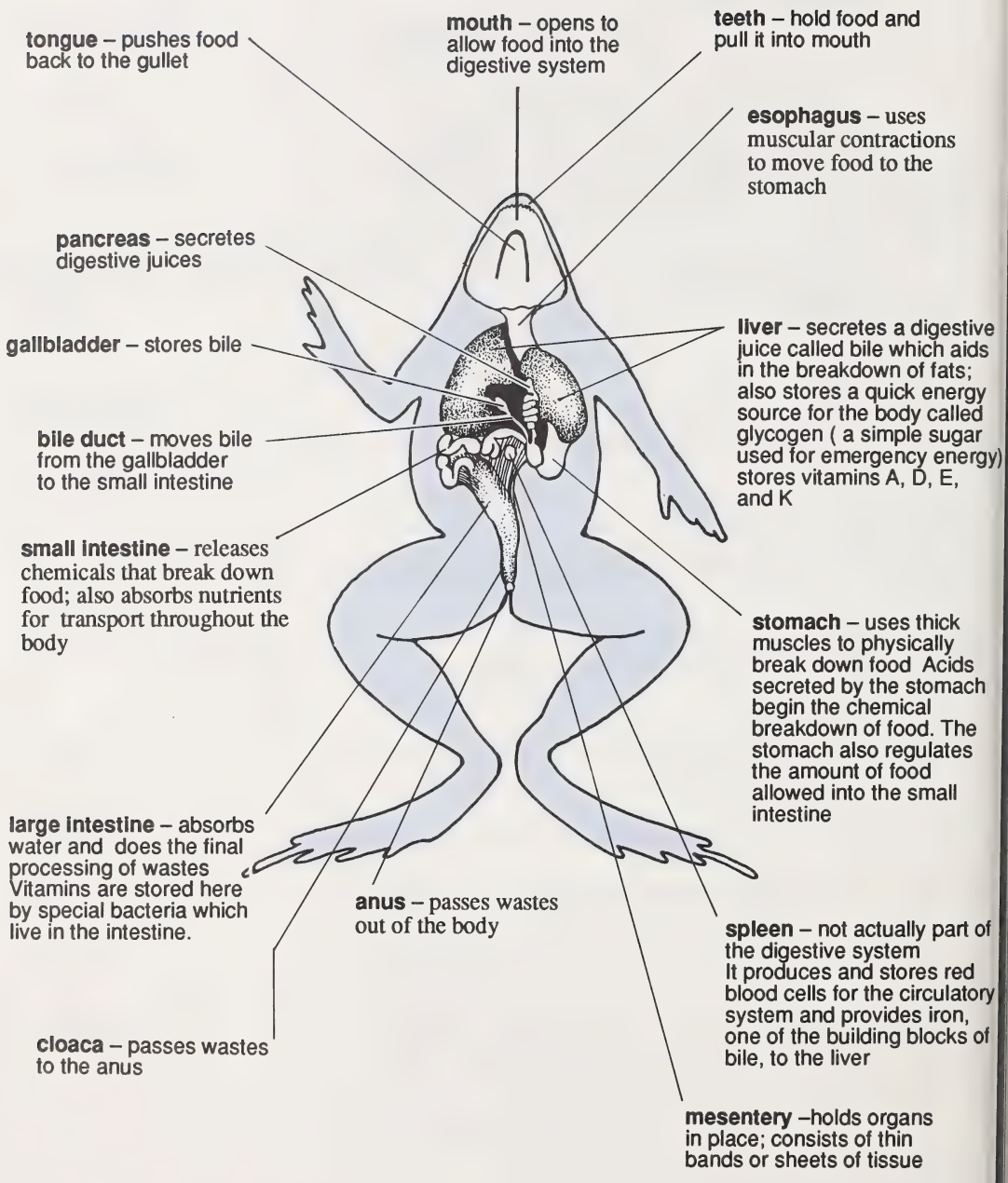
3. ☐ Yes ☑ No

   The human digestive system is not as simple as the worm's.

4. ☐ Yes ☑ No

   The frog and the worm have different digestive systems.

5.


tongue – pushes food back to the gullet
mouth – opens to allow food into the digestive system
teeth – hold food and pull it into mouth
esophagus – uses muscular contractions to move food to the stomach
pancreas – secretes digestive juices
gallbladder – stores bile
liver – secretes a digestive juice called bile which aids in the breakdown of fats; also stores a quick energy source for the body called glycogen (a simple sugar used for emergency energy) stores vitamins A, D, E, and K
bile duct – moves bile from the gallbladder to the small intestine
small intestine – releases chemicals that break down food; also absorbs nutrients for transport throughout the body
stomach – uses thick muscles to physically break down food Acids secreted by the stomach begin the chemical breakdown of food. The stomach also regulates the amount of food allowed into the small intestine
large intestine – absorbs water and does the final processing of wastes Vitamins are stored here by special bacteria which live in the intestine.
anus – passes wastes out of the body
spleen – not actually part of the digestive system It produces and stores red blood cells for the circulatory system and provides iron, one of the building blocks of bile, to the liver
cloaca – passes wastes to the anus
mesentery –holds organs in place; consists of thin bands or sheets of tissue

6. The digestive systems of the frog and the worm both have a mouth, an esophagus, a small intestine, and an anus.

7. The human digestive system is more complex than the digestive system of the frog.

8. teeth: used to break down food into pieces that are easy to swallow

   tongue: positions food for chewing and moves it to the pharynx

   pharynx: the entrance to the esophagus

   esophagus: uses muscular contractions to move food to the stomach

   stomach: uses acid to start the chemical digestion of food; stores food and regulates the amounts allowed into the small intestine

   liver: secretes bile, stores glycogen and vitamins A, D, E, and K

   gallbladder: stores bile

   bile duct: moves bile from the gallbladder to the small intestine

   pancreas: secretes digestive juices

   small intestine: releases chemicals that break down food; also absorbs nutrients for transport throughout the body

   large intestine: absorbs water and vitamins into the bloodstream

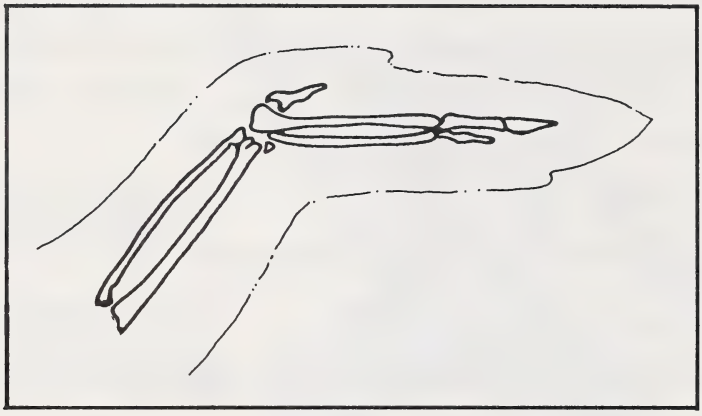
   mesentery: consists of thin bands or sheets of tissue which hold the organs in place

   anus: passes wastes out of the body

Section 1: Activity 2

Investigation: Chickens Have Bones, Too!

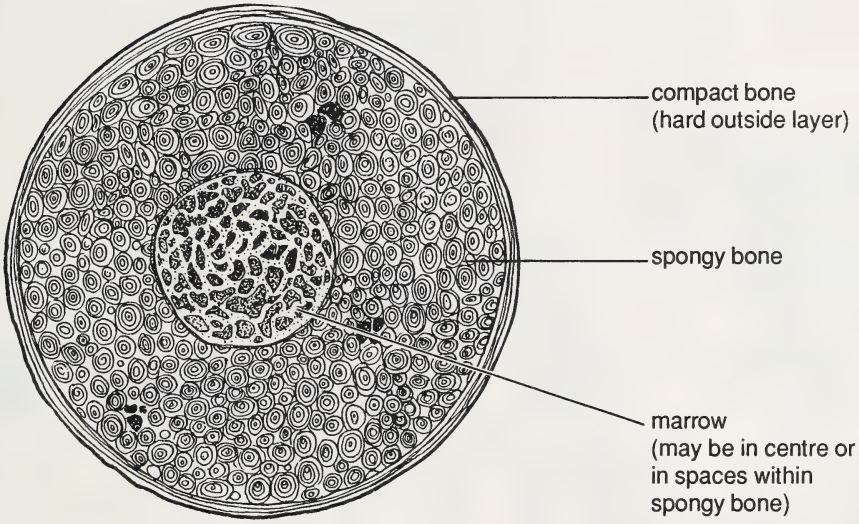
1. The wing bends in the middle and slightly at the wing tip.
2. Joint, articulation, and elbow are all possible answers.
3. Your diagram should look something like this.



4. You should find that the ligament feels hard, slippery, smooth, slick, etc.
5. No, the bone was not easy to cut.

   You could have found the bone hard to cut because it was made out of hard material, it was slippery to hold, or the spongy material inside the bone absorbed the impact.

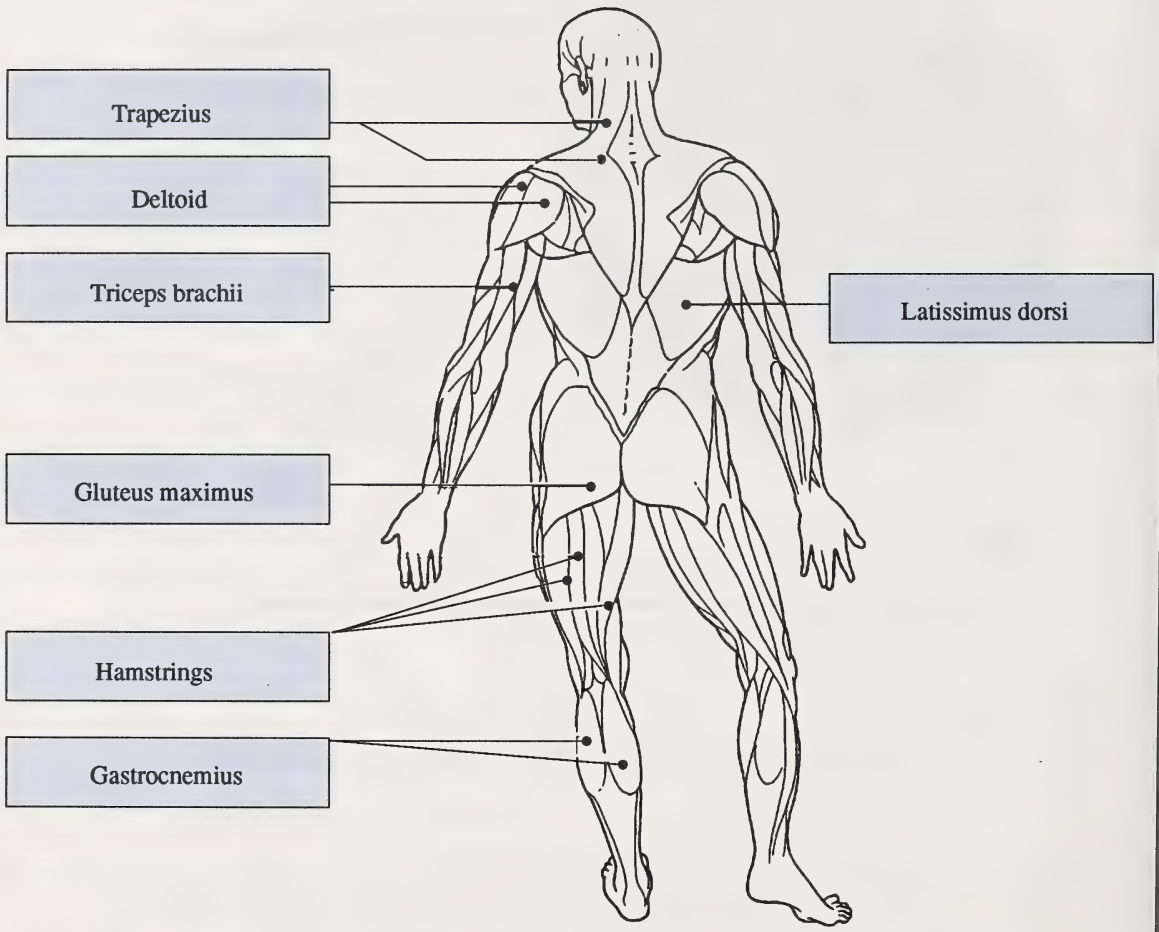
6. cross section of a chicken bone



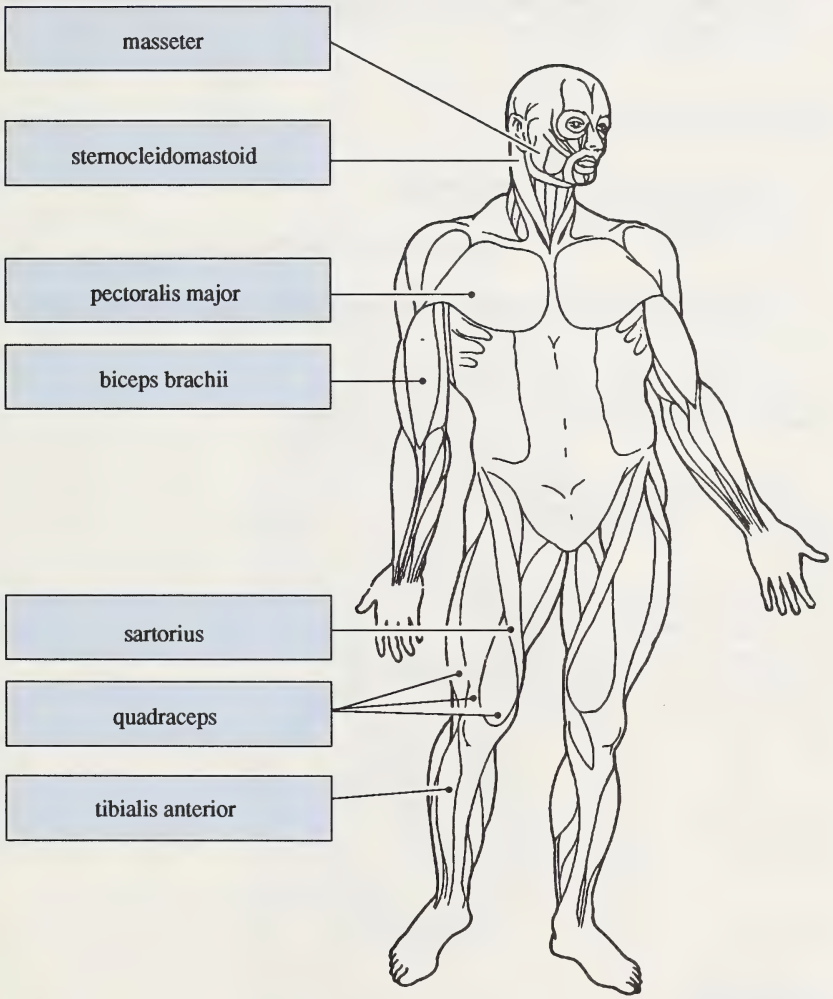
Section 1: Activity 3

1. The muscular system allows you to move the internal framework of bone.

2. a.


Trapezius
Deltoid
Triceps brachii
Gluteus maximus
Hamstrings
Gastrocnemius
Latissimus dorsi

b.


masseter
sternocleidomastoid
pectoralis major
biceps brachii
sartorius
quadraceps
tibialis anterior

3. Muscles are grouped in pairs around each joint. One muscle contracts to bend a joint, while the other muscle will contract to straighten the joint.

4. All of the joints in your body must have muscles working in pairs or you would end up with joints stuck in one position.

Section 1: Activity 4

1. The brain is the body's natural computer.

2. Your leg should make a jerking movement, swinging outward.

3. The tap on the knee stimulated a nerve which made a muscle contract and the lower leg move.

Investigation: Reaction Times

Part A: A Control Situation

STEP D	OBSERVATION
	Your average reaction time should be somewhere between 0.08 seconds (a fast hand speed) and 0.5 seconds (a slow hand speed).

Conclusions

4. decrease

5. Your increase in hand speed (a lower reaction time) is probably due to learning and/or repetition of the activity.

Part B: An Unexpected Event

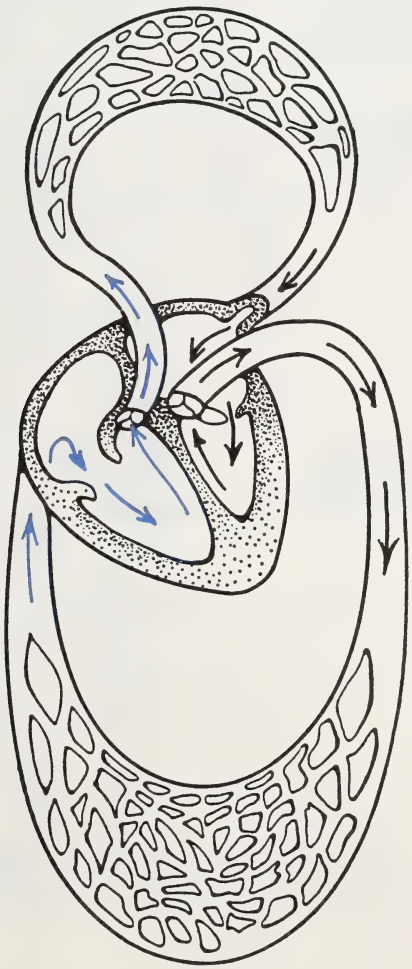
6. Your number of catches will usually be zero, but there may be times when you do catch the bill. A high number of catches means that you were not doing the exercise properly.

7.

skin	c.
ear	e.
tongue	d.
eye	a.
nose	b.

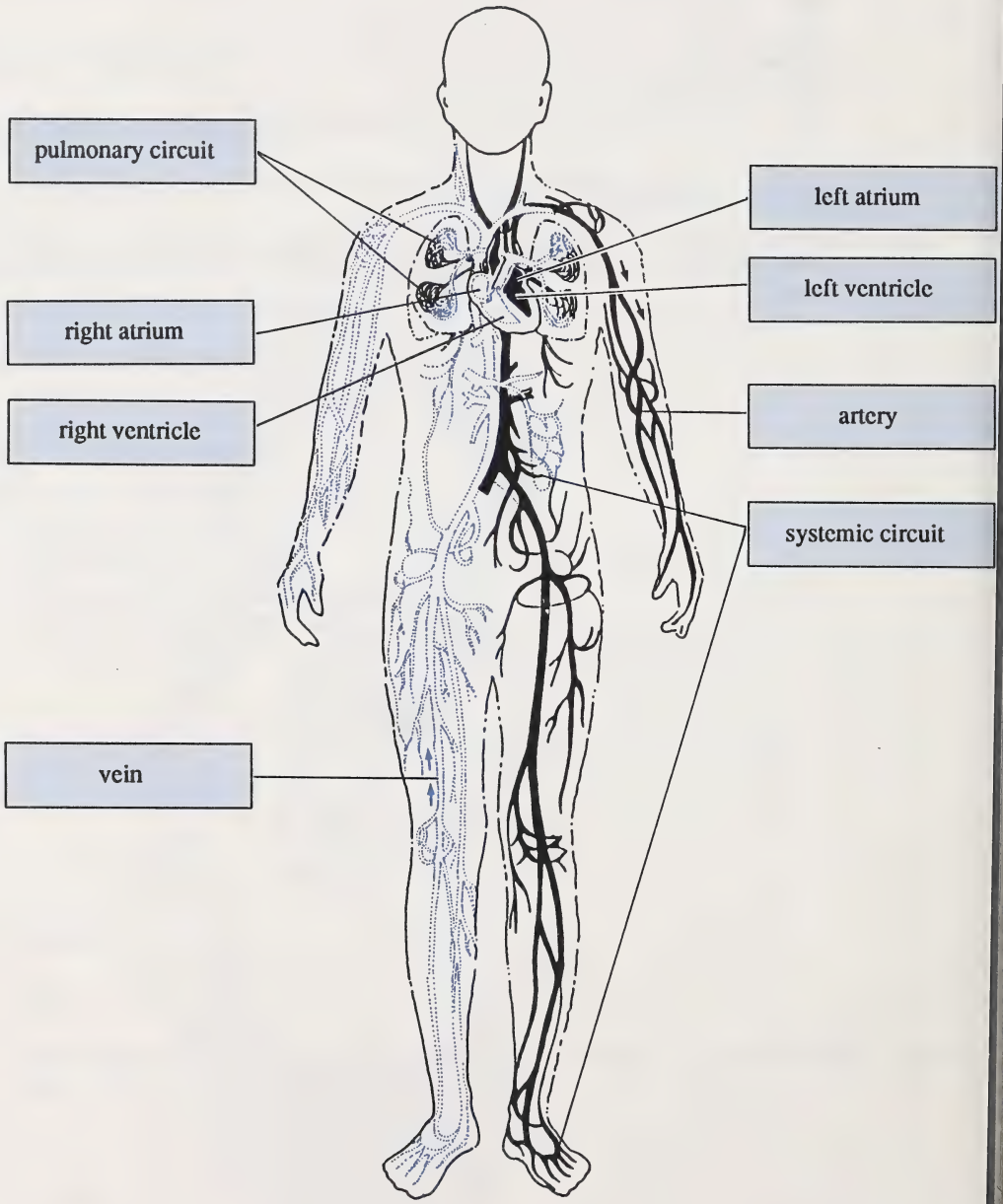
Section 1: Activity 5

1. The right ventricle pumps blood to the lungs, and the left ventricle pumps blood to the rest of the body.



2. Mixing the blood will reduce the amount of oxygen in the blood being pumped to the rest of the body. Your cells require high oxygen levels to function properly.

3.



Section 1: Activity 6

1. a. The adrenals glands are needed for when you get into an emergency situation.

   b. The adrenals give your entire body a chemical boost, preparing you to deal with the emergency.

2. a. male: testis or testes (plural)

   These reproductive glands produce sperm and stimulate the development of male secondary sex characteristics.

   b. female: ovary or ovaries (plural)

   These reproductive glands produce eggs and develop female secondary sex characteristics. The ovaries also secrete hormones which maintain pregnancy and aid in childbirth.

3. Insulin and glycagon are the two hormones secreted by the pancreas.

4. The target organ is the liver.

5. Insulin would be released by the pancreas to reduce the level of glucose in your blood. Your blood sugar level would be rising as glucose from the soft drink and the chocolate bar entered your circulatory system.

Section 1: Follow-up Activities

Extra Help

The functions or definitions for each term is as follows:

digestive system: the system within the body which converts food to fuel and raw materials that can be used by the body

hypothesis: an educated guess or good estimate; what you think the correct answer is

organ: a body part or group of tissues that does a specific function for the body

mouth: the opening through which food is taken in or ingested

esophagus: a muscular tube which moves food to the stomach

small intestine: a long tube where the absorption of nutrients occurs
Chemicals are released by the small intestine that break down food into pieces that can easily be carried by the bloodstream to the rest of the body.

compact bone: hard, dense bone made of calcium and fibres

articulation: the point where two bones meet
Usually some sort of bending occurs at the joint (articulation).

spongy bone: bone made of calcium but containing many narrow spaces giving it a spongy appearance

reaction time: the time it takes you to react to a situation

autonomic nervous system: the set of nerves which automatically control body functions such as breathing, heart rate, etc.

artery: a vessel that carries blood away from the heart

vein: a vessel that carries blood to the heart

Section 2: Activity 1

Investigation: A Homemade Microscope

1. The *e* gets larger and its image is inverted or flipped over.

2. The print on the page will flip and appear right-side-up.

Investigation: Use and Care of the Compound Microscope

3. a. stage clips
   b. body tube
   c. objective
   d. diaphragm

4. At lower power the letter *e* would look something like the following diagram.

The *e* is not solid black and the edges are fuzzy. With a microscope you can see spots where the ink was not absorbed and spots where the ink ran slightly outside the boundaries of the letter *e*.

5. The image moves to the left when you push the slide to the right.

6. The image moves toward you when you push the slide away from you.

7. a. The field of view is smaller at high power than at low power.

   b. Yes, the image appears less bright, or dimmer, at high power.

8. No, you cannot see the entire *e* when looking through the high power objective.

   The field of view becomes smaller as you switch from the low to the high power objective. When using the higher power objective for magnification you are actually looking at a smaller area under the microscope. The entire letter *e* does not fit into this smaller area.

Section 2: Activity 2

1. Your six important body systems are the muscle system, skeletal system, digestive system, circulatory system, nervous system, and the endocrine system.

2. a. oral groove
   b. mouth
   c. gullet
   d. food vacuole
   e. forming food vacuole
   f. anal pore

3. a. trichocyst
   b. macronucleus
   c. micronucleus
   d. cilia

4. a. pellicle
   b. contractile vacuole
   c. cilia

Section 2: Follow-up Activities

Extra Help

The functions or definitions for each term is as follows:

microscope: a device consisting of two convex lenses which magnifies the object being looked at

***Paramecium*:** a single-celled organism that uses cilia to gather food and to move from one place to another

organelle: a specialized part of a cell that carries out a required function

food vacuole: the site for the digestion of food

macronucleus: the organelle which controls and regulates the day-to-day activities of the *Paramecium*

cilia: hair-like structures which wave to move the *Paramecium* and to move food into the mouth and gullet
The cilia also provide a sense of touch for the *Paramecium*.

pellicle: the thick outer wall that gives the *Paramecium* its shape

contractile vacuole: the organelle which gathers and expels excess water out of the *Paramecium*

endoplasm: the fluid which circulates within the *Paramecium* to provide the nutrients needed by all organelles

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